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**CONTENS**

**Articles**



**Short notes**

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# Many-sided evaluation of the extensive synchronous sampling of small mammals (Insectivora, Rodentia) in lowland forest

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**Ecology, spatial distribution, reproduction, *Apodemus*, *Clethrionomys***

**Abstract.** The line transect consisting of 1545 snap-traps was laid in ecotones of lowland forest situated on the confluence of Vltava and Labe rivers in Central Bohemia. Traps were exposed for 3 nights in early April 1992. The total catch consisted of 527 animals belonging to seven species. Basic parameters of the synusy and reproduction of individual species were described. *Clethrionomys glareolus* (D=59%), *Apodemus flavicollis* (D=25%) and *Apodemus sylvaticus* (D=9%) were dominant species, their relative abundances (number of animals per trap in the first day of trapping) were 10.3, 5.8 and 3.2, respectively. Average litter size was 5.07 in *A. flavicollis* (n=29). We attempted to use data on the distribution of animals along the transect for the analysis of both interspecific and intraspecific relationships. Abundances of individual species are not correlated to each other. In *A. flavicollis* male-female pairs captured in the same or neighbouring trap were more frequent than unisexual pairs.

## INTRODUCTION

Snap-traps laid in lines or quadrats were frequently used in ecological studies in small rodents and insectivors. Millions of traps were laid, thousands of animals were killed and numerous studies based on these methods were published. Majority of these data sets were used for the precise density estimation and description of annual and population cycles. It is evident that such data may tell us also important information about spatial organisation of small mammal communities and populations, which can illustrate features of social organisation and interspecific relationships. The only condition is sufficient, i.e., extremely large, size of synchronous sample. Unfortunately, having in mind apparent fluctuations in diachrony, majority of authors underestimated synchronous point of view. We attempted to use long continuous line transect of snap-traps in order to collect synchronous data in the field. The trap-line was chosen because of more simple evaluation of one-dimensional data. Timing of the research was precisely planned in order to collect data after the start of the reproductive season and stabilisation of social and spatial organization, but before the appearance of the animals born in the current year.

## STUDY AREA, METHODS AND MATERIAL

The investigations were conducted in a large lowland forest called "Úpor Forest" situated on confluence of the Vltava and Labe rivers near the town of Mělník (Central Bohemia). A snap-trap line was constructed in ecotones along the periphery of Úpor Forest. Transect was situated in the inner (woodland) part of ecotones (wood-field, wood-meadow, wood-clearing, wood-

track), the most frequently about 5 metres from the forest border. The line was arranged in a circle-like manner. The circle was not fully closed, the transect was interrupted between the traps No.1542 and No.1. For the detail description of vegetation cover and line transect see Sádlo et al. (in prep.).

Altogether, 1542 snap-traps (size 10 x 5 cm) of the common type were used in 7.7 km line transect. Traps were spaced approximately 5 metres, and exposed during 3 successive nights starting from April 11-th 1992. Traps were baited with standard bait: pieces of wick fried in fat and flour. During 4626 trap-nights 527 animals were captured. Day, number and location of trap were recorded for each animal.

After capture, all specimens were weighted, measured, and dissected, and the condition of their sexual organs was ascertained. Ear length and hind foot length were measured with the precision of 0.1 mm. Body length and tail length were recorded to the nearest millimetre. Body weight was identified with the precision of 0.1 gram.

In males, the condition and size of testes were recorded, their length and width were measured with the precision of 0.1 mm. Area of cross-section of the testes (AC-ST) was computed using formula: AC-ST [mm2] = testis length [mm] . testis width [mm] . 3.1415 1/4. In addition, the length of vesicular glands was measured from the point of their fusion to the outmost margin of their curvature.

In females, number of embryos and their length (taken in the longitudinal axis) were recorded as well as the number of placental scars. Embryos being conspicuously smaller than the remaining ones of the set, were considered as resorbed. On the basis of relationship between the length of an embryo and its weight as described in *C. glareolus* by Zejda (1968), weight of embryos in the set was calculated. Only net body weight of females without embryos was used in further analysis.

The term "mature" female is used for specimens which have already taken part in the reproduction, i.e., for females being either actually pregnant or lactant, or showing traces of the reproductive activity from the past - placental scars. On the contrary, for females which probably never have attained pregnancy during their life the denotation "immature" is used.

The material is deposited in the collections of the Department of Zoology, Charles University, Prague.

All the statistical treatments were performed using the programme Statgraphics version 4.2.

## RESULTS

### Basic characteristics

Abundance and synusy

In total 527 specimens belonging to 7 species were captured: 311 specimens (198 males and 113 females) of *Clethrionomys glareolus* (Schreber, 1780), 134 specimens (64 males and 70 females) of *Apodemus flavicollis* (Melchior, 1834) , 49 (27 males and 22 females) specimens of *Apodemus sylvaticus* (Linnaeus, 1758), 25 specimens (18 males and 7 females) of *Sorex araneus* (Linnaeus), 1758, 4 specimens (3 males and 1 female) of *Microtus arvalis* (Pallas, 1779), 3 specimens (2 males and 1 female) of (*Sorex minutus* Linnaeus, 1766), and 1 specimen (female) of *Pitymys subterraneus* (Selys Longchamps, 1836), (Table 1).

Dominant species: *C. glareolus* (59.0%), *A. flavicollis* (25.4%) and *A. sylvaticus* (9.3%) were used in further analysis. Other species were influent (*S. araneus* - 4.7%) or accessory (*M .arvalis* - 0.8%, *S. minutus* - 0.6%, *P. subterraneus* - 0.2%).

For the purpose of computing frequency the transect was divided into 31 samples each equal to standard line, i.e., 50 traps (or 42 traps in last sample) and about 250 m long. *A. flavicollis* was

present in all (F=100%) and *C. glareolus* in 30 (F=97%) of the 31 samples; hence, they can be denotated as the eufrequent species (in sensu Balogh 1958). *A. sylvaticus* was found in 19 samples (F=61%) and *S. araneus* in 12 samples (F=39%), the former could be described as the frequent and the later as the accessory species. *M. arvalis* (2 samples, F=6%), *S. minutus* and *P. subterraneus* (1 sample, F=3%) must be considered the accidentary species in the community under study.

Relative abundance of the synusy was 11.3 individuals per 100 trap-nights, the corresponding value computed separately for the first day of trapping being 18.9 (Table 1).

The probability of capture (Leslie & Davis 1939) computed for dominant species ranged from 0.29 for females of A.sylvaticus to 0.74 for males of *A. flavicollis* (Table 2).

Population density was calculated from estimated catch size. For the conversion of estimated catch size to the number per hectare, we used a stripe according to Pelikán (1975a). Widths of stripes were given according to Pelikán (1975b) as 40 metres for males and 20 metres for females in *C. glareolus* and in *A. sylvaticus* 60 metres for males and 35 metres for females. In *A. flavicollis* we used width 70 metres for males and 50 metres for females, in accordance with Rödl (1974a,b). The highest density was found in *C. glareolus* - 17.4 individuals per hectare, while in *A. flavicollis* it was only 3.2 ind. per hectare and in wood mouse even 1.9 ind. per hectare.

Indices of species diversity (Shannon & Wiener 1963) and equitability (Sheldon 1969) were H'= 1.59 and J'= 0.57, respectively.

### Sexual activity and reproduction

Overwintered individuals prevailed in the populations of all the species under study. The only exception was one juvenile pelaged male *A. flavicollis* weighting 13.5g, apparently born in the current year.

Sex ratio could be evaluated in two most abundant species. It was approximately balanced in *A. flavicollis* (47.8%, n=134), while the predominance of males is marked and significant in *C. glareolus* (63.7%, n=311, Chi-square=11.6).

Overwintered males of all species were sexually active with fully developed testes and vesicular glands (Table 3).

Intensity of reproduction in females varied between species. 64% of 70 females and 45% of 22 females were found actually pregnant or lactant in *A. flavicollis* and in *A. sylvaticus*, respectively, while in *C. glareolus* it was only 12% of 104 females (Table 4). These differences can be attributed to variation in the beginning of the reproductive season. All females in the *M. arvalis* (n=1) and the *P. subterraneus* (n=1) were pregnant.

Data on litter size and embryonic resorption are given in Tables 5 and 6.

### Body measures and weight

Biometric data for overwintered specimens of dominant species are given in Tables 7-8 and Figure 1. Low variability, especially in *C. glareolus*, is apparent. Differences in body weight and hind foot length between *A. flavicollis* and *A. sylvaticus* are marked as evident from Figure 2. These differences as well as coloration pattern of the pelage allowed the reliable taxonomic determination of the material.

## Interspecific and intraspecific spatial relationships

The following part of results is based on analysis of spatial relationships among species and between sexes. For this purpose we used data on the distribution of animals captured along the

Table 1. Number of individuals captured (n), relative abundance (A) and dominancy (D) computed for the total material. Number of individuals (*n1*) and relative abundance (*A1*) computed for the first trapping day only. Relative abundance is given as nuumber of individuals captured per 100 trap-nights.

| Species | n | A | n1 | A1 | D[%] |
|---|---|---|---|---|---|
| *C. glareolus* | 311 | 6.72 | 159 | 10.31 | 59.0 |
| *A. flavicollis* | 134 | 2.90 | 90 | 5.83 | 25.4 |
| *A. sylvaticus* | 49 | 1.06 | 26 | 3.18 | 9.3 |
| *S. araneus* | 25 | 0.54 | 14 | 0.91 | 4.7 |
| *M. arvalis* | 4 | 0.08 | 3 | 0.19 | 0.8 |
| *S. minutus* | 3 | 0.06 | 0 | 0.00 | 0.6 |
| *P. subterraneus* | 1 | 0.02 | 0 | 0.00 | 0.2 |
| Total | 527 | 11.29 | 292 | 18.94 | 100.0 |

Table 2. Number of individuals captured - actual catch size (N), probability of capture (p), estimated catch size (N), effective area [ha], and density [individuals per ha]

| Species | N | p | N | ha | Ind./ha |
|---|---|---|---|---|---|
| *A. flavicollis* | | | | | |
| Males | 64 | 0.74 | 64.9 | 53.97 | 1.20 |
| Females | 70 | 0.54 | 77.8 | 38.55 | 2.02 |
| Total | 134 | | | | 3.22 |
| *A. sylvaticus* | | | | | |
| Males | 27 | 0.53 | 30.2 | 46.26 | 0.65 |
| Females | 22 | 0.29 | 34.5 | 26.99 | 1.28 |
| Total | 49 | | | | 1.93 |
| *C. glareolus* | | | | | |
| Males | 198 | 0.39 | 256.4 | 30.84 | 8.32 |
| Females | 113 | 0.42 | 140.5 | 15.42 | 9.11 |
| Total | 311 | | | | 17.43 |

Table 3. Mean testes size (AC-ST area of the cross-section of the testes) and length of vesiculae seminales in overwintered males of dominant species

| Species | n | Mean | S.D. | S.E. | Min. | Max. |
|---|---|---|---|---|---|---|
| Testes size AC-ST [mm2]: | | | | | | |
| *A. flavicollis* | 62 | 80.5 | 10.4 | 1.3 | 46 | 108 |
| *A. sylvaticus* | 26 | 82.3 | 8.7 | 1.7 | 69 | 100 |
| *C. glareolus* | 195 | 71.8 | 8.4 | .6 | 44 | 97 |
| Length of vesiculae seminales [mm]: | | | | | | |
| *A. flavicollis* | 63 | 14.9 | 1.7 | .2 | 11 | 19 |
| *A. sylvaticus* | 26 | 13.1 | 1.6 | .3 | 10 | 15 |
| *C. glareolus* | 195 | 12.1 | 1.8 | .1 | 9 | 16 |

Table 4. Proportion of sexually active and inactive females in the sample [%]

| Species | n | sexually active pregnant | sexually active lactant | % | sexually inactive mature | inactive immature |
|---|---|---|---|---|---|---|
| *A. flavicollis* | 70 | 29 | 16 | 64 | 0 | 23 |
| *A. sylvaticus* | 22 | 8 | 2 | 45 | 1 | 11 |
| *C. glareolus* | 104 | 7 | 5 | 12 | 4 | 88 |

Table 5. Litter size in dominant species

| Species | Litter size 2 | 3 | 4 | 5 | 6 | 7 | 8 | n | Mean |
|---|---|---|---|---|---|---|---|---|---|
| *A. flavicollis* | 1 | - | 6 | 11 | 11 | - | - | 29 | 5.07 |
| *A. sylvaticus* | - | - | 1 | 4 | 2 | 1 | - | 8 | 5.38 |
| *C. glareolus* | - | 1 | 3 | 2 | | - | 1 | 7 | 4.71 |

Table 6. Embryonic resorption in Apodemus flavicollis

| | Litter size 2 | 4 | 5 | 6 | n |
|---|---|---|---|---|---|
| sets | 1 | 6 | 11 | 11 | 29 |
| resorbed | 0 | 2 | 1 | 1 | 4 |
| % | | | | | 14 |
| embryos | 4 | 24 | 55 | 66 | 149 |
| resorbed | 0 | 3 | 2 | 1 | 6 |
| % | | | | | 4 |

Note: In C glareolus resorption was found in one of seven litters examined. Two of three embryos in the set were affected.

Table 7. Mean body weight and hind foot length in overwintered specimens of dominant species. (F – females; M – males)

| Species | n | Mean | S D. | S.E. | Min. | Max. |
|---|---|---|---|---|---|---|
| Body weight [g]: | | | | | | |
| *A. flavicollis* F | 66 | 30.27 | 3.57 | .44 | 22.5 | 37.4 |
| M | 62 | 37.20 | 4.57 | .58 | 28.2 | 47.6 |
| *A. sylvaticus* F | 22 | 20.64 | 2.90 | .62 | 15.7 | 27.7 |
| M | 26 | 23.69 | 2.22 | .44 | 17.2 | 27.9 |
| *C. glareolus* F | 109 | 20.57 | 2.00 | .19 | 16.3 | 25.6 |
| M | 195 | 25.39 | 2.00 | .14 | 19.4 | 31.1 |
| Length of the hind foot [mm]: | | | | | | |
| *A. flavicollis* F | 66 | 23.39 | 75 | .09 | 21.6 | 25.3 |
| M | 63 | 24.18 | .82 | .10 | 22.5 | 26.0 |
| *A. sylvaticus* F | 22 | 20.40 | .69 | .15 | 19.3 | 21.5 |
| M | 26 | 21.18 | .63 | .12 | 19.9 | 22.5 |
| *C. glareolus* F | 113 | 17.29 | .56 | .05 | 16.0 | 19.0 |
| M | 195 | 17.48 | .58 | .04 | 16.0 | 18.7 |

line transect, i.e., along the sequence of successive snap-traps. Data obtained during the first, second and third night of trapping were pooled. Using the tests of binary sequences or randomness we treated captured individuals in ordered sequence according to their trap numbers, while empty traps were excluded. In cases in which more animals were captured to the same trap, they were ordered according to the day of capture.

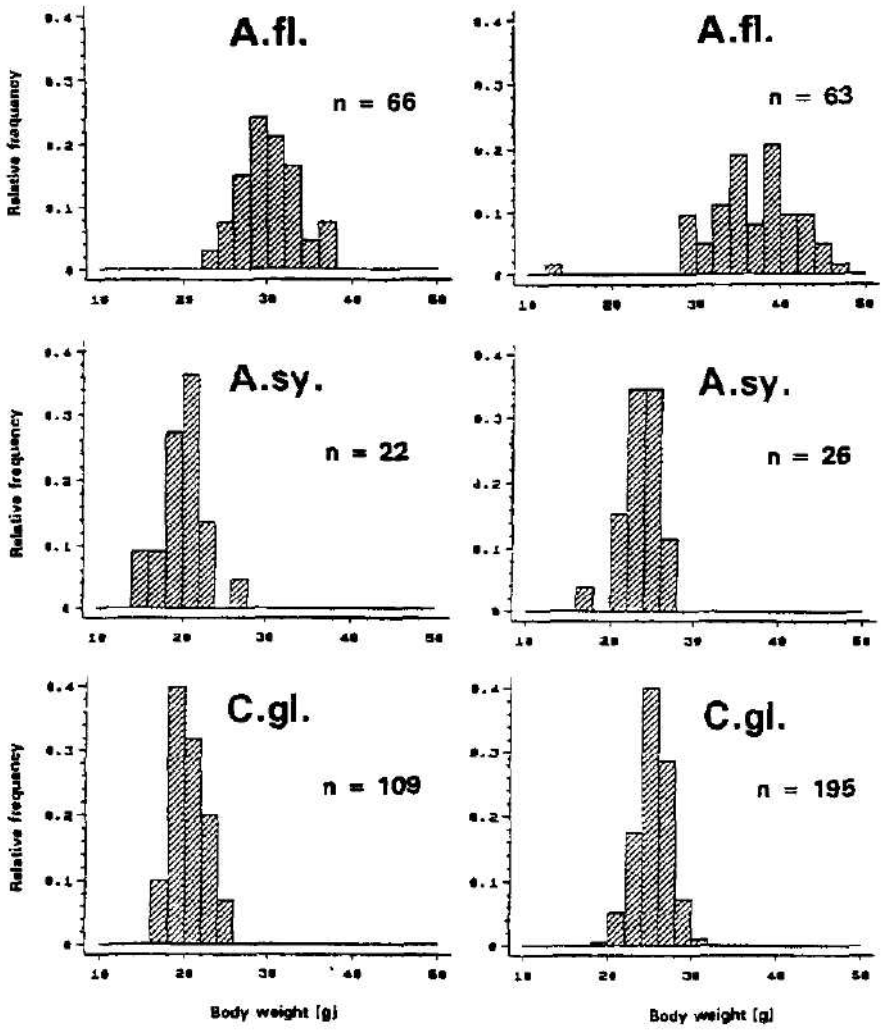


Fig. 1. Frequency histograms for body weight of dominant species. Explanations: A.sy - *Apodemus sylvaticus*, A.fl.- *Apodemus flavicollis*, C.gl. - *Clethrionomys glareolus;* left females; right males.

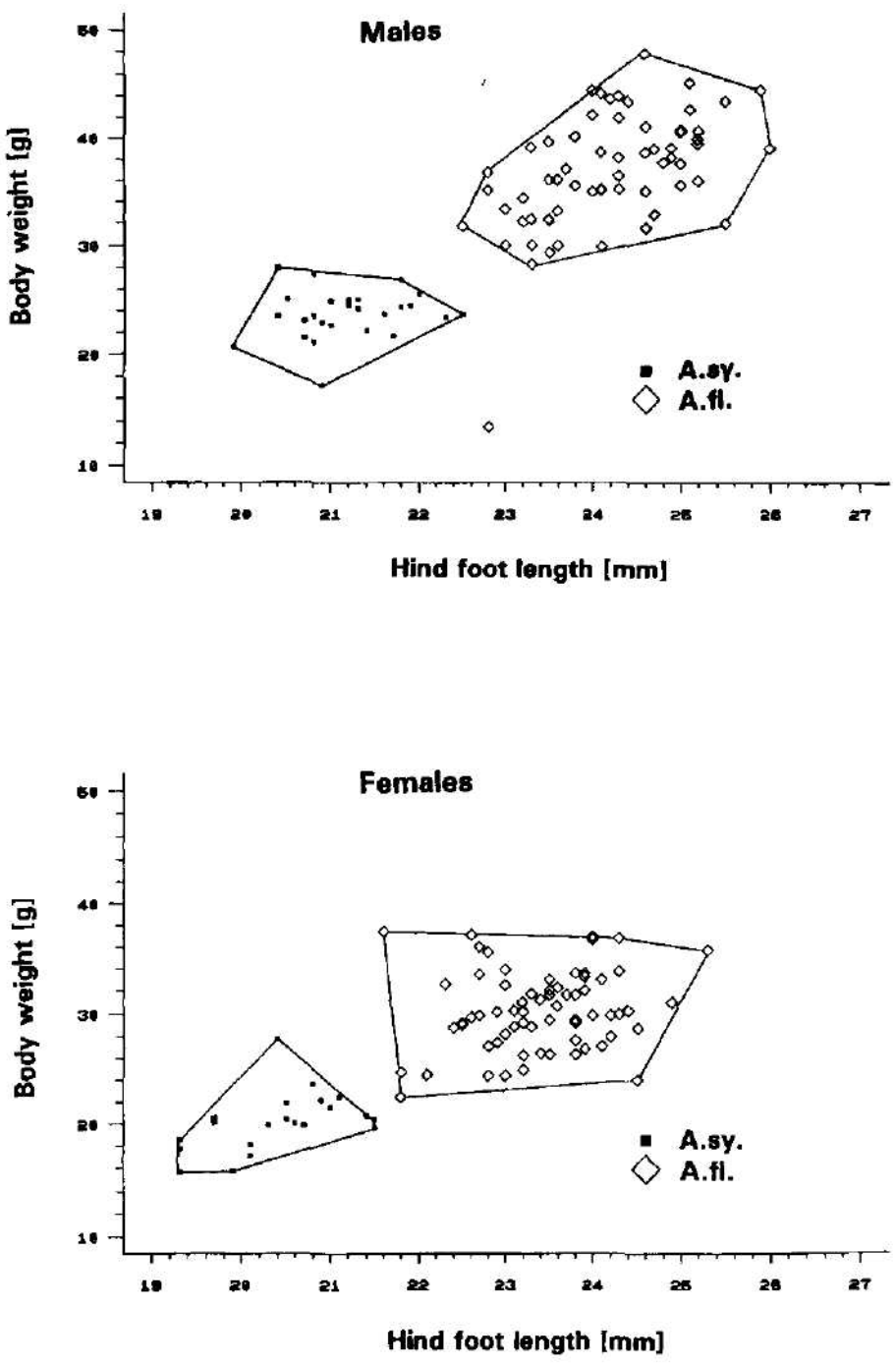


*Fig. 2. Scatter-plots of body weight and hind foot length for Apodemus sp.*

Interspecific comparisons

In order to compare the general distribution pattern of different species, we computed the smoothed relative abundance per trap (i.e., average value for each trap and certain number of neighbouring traps) for each dominant species. Smoothing was made for 21 traps (i.e., 100 m) and 11 traps (i.e., 50 m). No obvious correlation among distribution patterns of individual species is visible from the plot of the smoothed relative abundance (Figure 3). Also correlation coefficients of these data indicate unimportance of interspecific interactions (Spearman rank

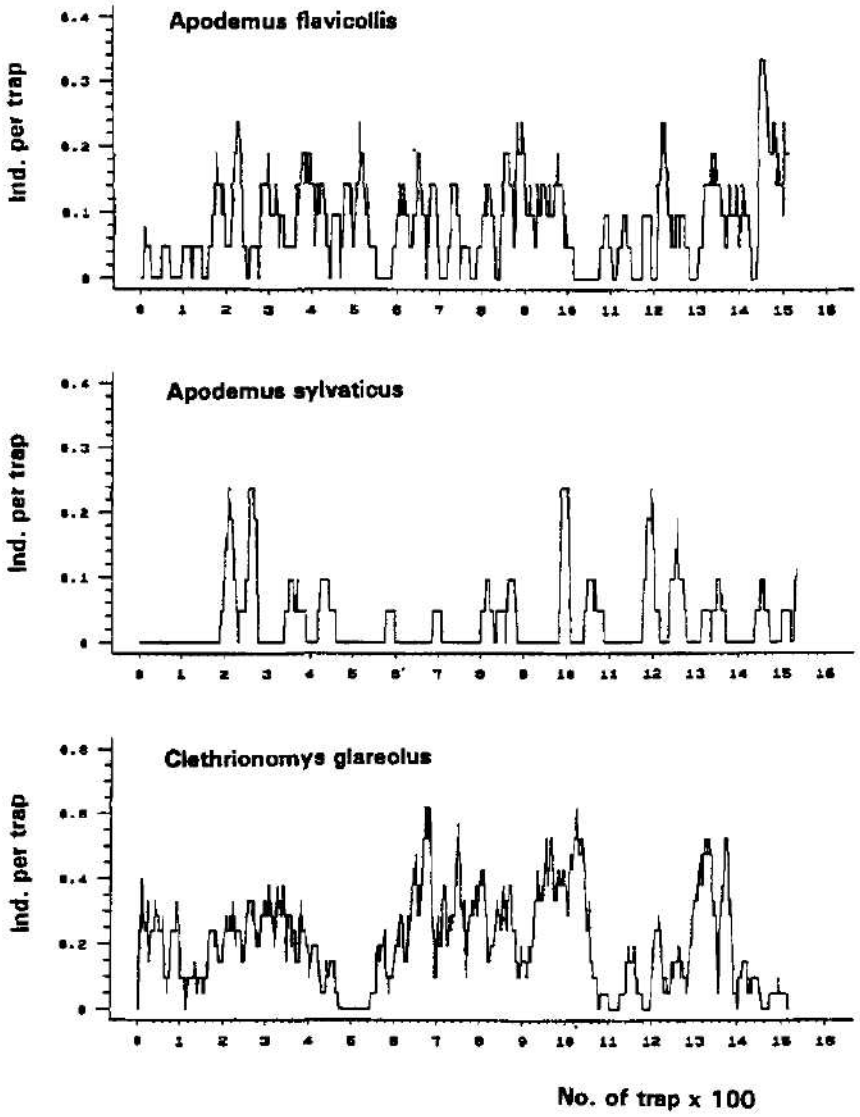


Fig. 3. Variation in relative abundance [individuals per trap] along the transect - data smoothed for 21 traps.

Table 8. Mean body length, tail length and ear length in overwintered specimens of dominant species

| Species | n | Mean | S.D. | S.E. | Min. | Max. |
|---|---|---|---|---|---|---|
| Body length [mm]: | | | | | | |
| *A. flavicollis* F | 65 | 103.60 | 4.22 | .52 | 94 | 115 |
| M | 62 | 109.47 | 5.95 | .76 | 80 | 120 |
| *A. sylvaticus* F | 22 | 90.91 | 4.56 | .97 | 85 | 102 |
| M | 26 | 95.58 | 2.89 | .57 | 91 | 102 |
| *C. glareolus* F | 111 | 95.52 | 4.56 | .43 | 83 | 106 |
| M | 194 | 99.81 | 3.85 | .28 | 88 | 109 |
| Tail length [mm] | | | | | | |
| *A. flavicollis* F | 52 | 103.50 | 6.62 | .92 | 80 | 113 |
| M | 57 | 105.88 | 7.66 | 1.01 | 78 | 122 |
| *A. sylvaticus* F | 18 | 80.78 | 4.83 | 1.14 | 71 | 88 |
| M | 23 | 84.83 | 4.71 | .98 | 76 | 94 |
| *C. glareolus* F | 110 | 45.25 | 3.43 | .33 | 38 | 54 |
| M | 184 | 47.30 | 2.95 | .22 | 41 | 57 |
| Ear length [mm]: | | | | | | |
| *A. flavicollis* F | 66 | 17.53 | .92 | .11 | 15 4 | 19.6 |
| M | 62 | 18.01 | 1.07 | .14 | 14.6 | 20.1 |
| *A. sylvaticus* F | 22 | 15.81 | .64 | .14 | 14.4 | 19.6 |
| M | 26 | 16.02 | .74 | .15 | 14.3 | 20.1 |

Table 9. Spearman coefficients of correlation for relative abundances smoothed for 11 traps

| | *C. glareolus* | | *A. flavicollis* | | *A. sylvaticus* | |
|---|---|---|---|---|---|---|
| | males | females | males | females | males | females |
| *C. glareolus* males | x | | | | | |
| *C. glareolus* females | +0.32 | x | | | | |
| *A. flavicollis* males | -0.02 | -0.07 | x | | | |
| *A. flavicollis* females | -0.02 | -0.12 | +0.21 | x | | |
| *A. sylvaticus* males | +0.04 | -0.02 | +0.04 | -0.05 | x | |
| *A. sylvaticus* females | -0.04 | +0.09 | +0.08 | -0.07 | +0.26 | x |

Table 10. Results of tests for binary sequences - interspecific comparisons

| | Number of runs | | | |
|---|---|---|---|---|
| | Observed | Expected | z | p |
| *A. flavicollis* x *A. sylvaticus* | 56 | 72.8 | -3.07 | 0.0021 |
| males A.f. x males A.s. | 34 | 39.0 | -1.13 | 0.2570 |
| females A.f. x females A.f. | 30 | 34.5 | -1.15 | 0.2497 |
| *A. flavicollis* x *C. glareolus* | 156 | 188.3 | -3.58 | 0.0003 |
| males A.f. x males C.g. | 86 | 97.7 | -1.89 | 0.0593 |
| females A.f. x females C.g. | 74 | 87.0 | -2.03 | 0.0421 |
| *A. sylvaticus* x *C. glareolus* | 70 | 85.7 | -3.41 | 0.0004 |
| males A.s. x males C.g. | 38 | 48.5 | -3.19 | 0.0014 |
| females A.s. x females C.g. | 34 | 37.8 | -1.06 | 0.2886 |

correlation coefficients for relative abundance smoothed for 21 traps: *A. flavicollis* x *C. glareolus* r=-0.029, *A. sylvaticus* x *C. glareolus* r=0.006, *A. flavicollis* x *A. sylvaticus* r=0.104). Smoothed values of relative abundance (11 traps) for conspecific sexes are positively correlated, while interspecific correlations are insignificant (Table 9).

We used also runs tests for binary sequences for original data (Table 10). Sequences of animals captured along the transect were treated separately for each pair of dominant species. The null hypothesis claims that the sequence is random. The results showed lower number of runs (iterations - sequences in which only one species was captured) than should be expected in a random order. However, significant differences disappeared (with the exception of following interactions: females *A. flavicollis* versus *C. glareolus*, males *A. sylvaticus* versus *C. glareolus*) after subdivision of material according to sexes. It may be caused both by intersexual interactions and by a small sample size. Evaluating these results we ought to keep in the mind that social organisation could influence the results. Social units, not simply individuals, ought to be evaluated in this analysis.

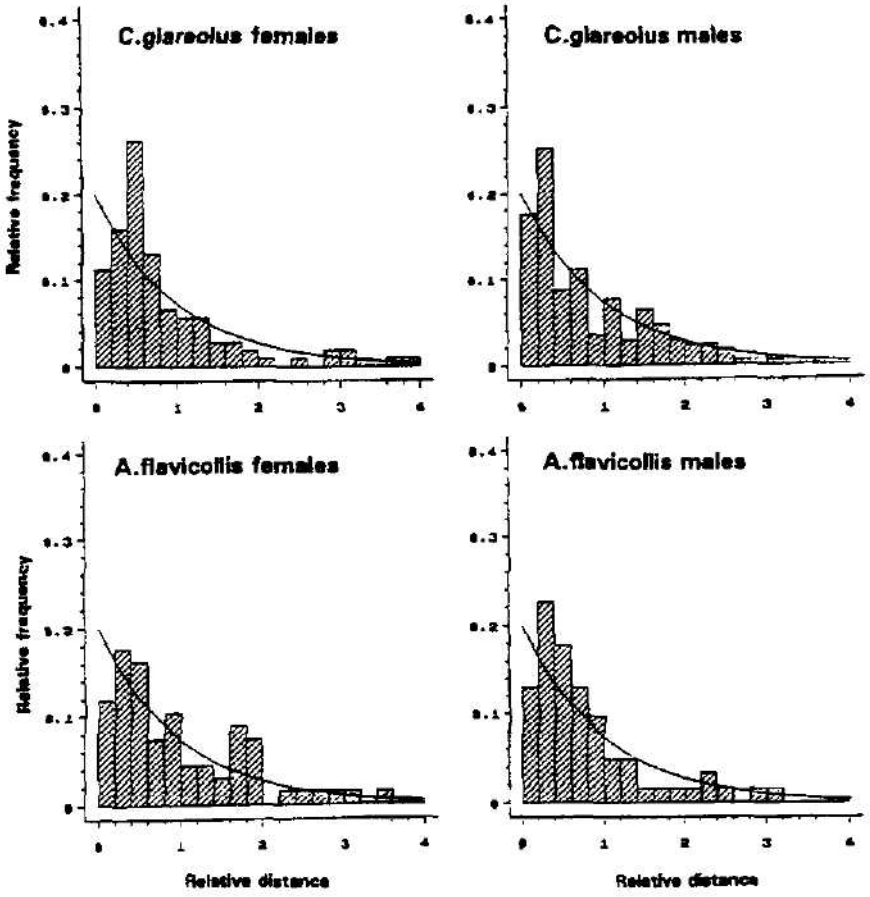


Fig. 4. Frequency histograms for relative distance, expressed as number of traps, between neighbouring conspecific individuals of the same sex divided by mean distance.

Table 11. Results of tests for binary sequences - comparison between sexes

| | Number of runs | | | |
|---|---|---|---|---|
| | Observed | Expected | z | p |
| *A. flavicollis* males x females | 70 | 67.8 | 0.28 | 0.776 |
| *A. sylvaticus* males x females | 22 | 25.2 | -1.09 | 0.274 |
| *C. glareolus* males x females | 149 | 144.9 | 0.44 | 0.657 |

Table 12. Number and composition of clusters of animals. Individuals are considered to be members of the same cluster on condition that neighbouring animals were captured to traps spaced 5 meters or less in the line transect (condition=5m). In addition, we used also more extended clusters containing animals spaced 15 m or less (condition=15m)

| Composition of cluster | *A flavicollis* | | *A. sylvaticus* | | *C. glareolus* |
|---|---|---|---|---|---|
| Condition: | 15 | 5 | 15 | 5 | 5 |
| male + male | 1 | 0 | 1 | 1 | 21 |
| male + female | 15 | 12 | 3 | 1 | 23 |
| female + female | 3 | 1 | 1 | 0 | 2 |
| male + 2 females | 5 | 3 | 0 | 1 | 1 |
| 2 males + female | 2 | 2 | 0 | 0 | 13 |
| 3 females | 0 | 0 | 0 | 0 | 0 |
| 3 males | 0 | 0 | 0 | 0 | 3 |
| 2 males + 2 females | 0 | 0 | 1 | 0 | 1 |
| male + 3 females | 1 | 0 | 0 | 0 | 0 |
| 3 males + female | 0 | 0 | 0 | 0 | 3 |
| 4 males | 0 | 0 | 0 | 1 | 1 |
| 2 males + 3 females | 0 | 0 | 0 | 0 | 2 |
| 4 males + female | 0 | 0 | 1 | 0 | 1 |

## Male-female relationships

We used runs tests for binary sequences in order to test the randomness of ordered sequence of conspecific males and females. Results shown at Table 11 are in accordance with the random distribution of sexes along the line-transect. However, the length of space between neighbouring animals is not evaluated in this method. Therefore we analysed composition of clusters of conspecific individuals (Table 12). Individuals were considered to be members of the same cluster on condition that neighbouring animals were captured to traps spaced 5 meters (15 meters) or less in the line transect. In *A. flavicollis* male-female clusters dominate over unisexual pairs (Chi-square=9.7, $p<0.01$).

In *C. glareolus* higher relative percentage of males was found in clusters (n=160, 110 males, 69%) than in non-clustered individuals (n=151, 88 males, 58%). However, this difference is an artefact caused by single criterion for identification of clustered individuals of both sexes interacting with unbalanced sex ratio.

No clear differences in trappability and sex ratio were found between the material obtained in areas of high and low relative abundance (Table 13).

Table 13. Sex ratio and trappability (expressed as proportion of animals captured during the first night of trapping (day 1) in animals captured in areas of high and low relative abundance (individuals per trap - smoothed data for 21 traps)

| Abundance | n | males | day1 | % | females | day1 | % | Sex ratio % |
|---|---|---|---|---|---|---|---|---|
| *C. glareolus* | | | | | | | | |
| low ( 0.25) | 131 | 83 | 42 | 51 | 48 | 23 | 48 | 63 |
| medium ( 0.35) | 88 | 58 | 27 | 47 | 30 | 13 | 43 | 66 |
| high ( 0.35) | 92 | 57 | 31 | 54 | 35 | 23 | 66 | 62 |
| *A. flavicollis* | | | | | | | | |
| low ( 0.14) | 49 | 24 | 21 | 88 | 25 | 15 | 60 | 49 |
| high ( 0.14) | 85 | 40 | 27 | 68 | 40 | 27 | 68 | 47 |
| *A. sylvaticus* | | | | | | | | |
| low ( 0.10) | 28 | 16 | 9 | (56) | 12 | 5 | (42) | 57 |
| high ( 0.10) | 21 | 11 | 7 | (64) | 10 | 5 | (50) | 52 |

Table 14. Results of tests for randomness (distance between individuals of the same species and sex)

| | n | Number of runs Observed | Expected | z | p |
|---|---|---|---|---|---|
| *A. flavicollis* males | 64 | 39 | 32.9 | 1.42 | 0.155 |
| *A. flavicollis* females | 70 | 43 | 36.0 | 1.57 | 0.118 |
| *C. glareolus* males | 198 | 97 | 99.6 | -0.31 | 0.759 |
| *C. glareolus* females | 113 | 59 | 57.5 | 0.19 | 0.849 |

Table 15. Results of tests for randomness (body weight)

| | Number of runs Observed | Expected | z | p |
|---|---|---|---|---|
| *A. flavicollis* males | 42 | 40.3 | 0.36 | 0.7191 |
| *A. flavicollis* females | 46 | 43.7 | 0.54 | 0.5873 |
| *A. sylvaticus* males | 19 | 17.0 | 0.72 | 0.4692 |
| *A. sylvaticus* females | 15 | 14.3 | 0.09 | 0.9299 |
| *C. glareolus* males | 127 | 127.7 | -0.02 | 0.9771 |
| *C. glareolus* females | 68 | 71.7 | -0.73 | 0.4661 |

## Intrasexual comparisons

In order to describe dispersion of animals on the transect we plotted frequency histograms for relative distances expressed as number of traps between neighbouring conspecific individuals of the same sex divided by average distance (Figure 4). Coeficients of variation (C.V. = standard deviation / mean) for these distances were higher in *C. glareolus* (females: C.V.=1.37, males: C.V.=1.60) than in *A. flavicollis* (females: C.V.=0.91, males: C.V.=1.33). However, tests for randomness (i.e., runs test for testing sequence of values above and below the median) did not

Table 16. Mean body weight in animals captured to the same or neighbouring trap as another conspecific animal of the oposite sex (group 1) compared with mean weight in other animals (group 2) of the same species and sex

| | Group 1 | | Group 2 | |
|---|---|---|---|---|
| | n | Mean | n | Mean |
| *A. flavicollis* males | 18 | 35.5 | 44 | 37.9 |
| *A. flavicollis* females | 19 | 30.0 | 47 | 30.4 |
| *C. glareolus* males | 56 | 25.6 | 139 | 25.3 |
| *C. glareolus* females | 47 | 20.9 | 62 | 20.3 |

show significant deviation from a random order in any species and sex (Table 14).

We used tests for randomness also for the testing of the distribution of body weight along the transect. In all posessed species (Table 15) the results are not in contradiction with random order.

Mean body weights of individuals within a cluster (i.e., two or more conspecific animals of the same sex captured to the same or neighbouring trap) were almost identical in both sexes of *A. flavicollis* and *C. glareolus*. Similar results were obtained after subdivision of the animals according to categories of smoothed relative abundance. Also the animals captured to the same or neighbouring trap as another conspecific animal of the oposite sex, if compared with other animals of the same species and sex, did not show any significant difference in their body weight. However, a slide tendency to lower weight was found in male *A. flavicollis* of this group (Table 16).

In *A. flavicollis* we tested if pregnant females are clustered or distributed at random. We used tests for binary sequences for pregnant and non-pregnant females. 34 runs (iterations) was found. It is in accordance with 34.97 the expected value for random sequence ($z=-0.12$, $p=0.91$).

## DISCUSSION

### Basic characteristics

Species composition as well as other basic parameters of the synusy found in "Úpor Forest" are in general accordance with that in lowland forests on the territory of Prague (Čiháková 19 89, Frynta et al. in prep.) or in Southern Moravia (Zejda 1973, 1976, Pelikán et al. 1974). Relative abundance and density of dominant species followed long-term averages given in literature cited above.

Reproductive parameters found in our sample are not in contradiction with literary data, either. Low proportion of pregnant or lactant females in our material of *C. glareolus* indicates that reproduction in this population just started at the time of our investigation. The onset of breeding was probably in late March, i.e., in the period close to that (early April) in which the beginning of *C. glareolus* reproductive season in Central Europe is most frequently reported (Bujalska 1983a). Predominance of males, which is apparent in our sample of *C. glareolus*, seems to be typical for overwintered animals of this species collected in spring (Bujalska 1983b). On the contrary, the proportion of breeding females was high in *A. sylvaticus* and especially in *A. flavicollis*, in which the presence of a juvenile male also indicates early onset of breeding. Similarly, beginning of the breeding season in *A. flavicollis* is earlier, than in *C. glareolus* in Southern Moravia (Zejda 1976).

Mean litter size 5.07 in our material of *A. flavicollis* is almost identical to long-term average value 5.04 reported by Pelikán (1966a). Also the proportions of pregnant females in our samples

of *A flavicollis* (41 4%, n=70) and *A sylvaticus* females (36 4%, n=22) are close to those given in literature for April samples from Southern Moravia (*A flavicollis* 55%, n=33; *A sylvaticus*: 47%, n=34, Pelikán 1966b) and Prague (*A sylvaticus*, 31%, n=52, Frynta & Vohralík in press)

Spatial relationships

The importance of spatial relationships and heterogenity is evident from the fact that spatial variation in abundance is frequently as large as the temporal range in population size, as reported by Montgomery (1989) for *A sylvaticus*

Evaluating spatial relationships among individuals of *Clethrionomys glareolus*, *A. flavicollis* and *A sylvaticus* in the sample, obtained by means of snap-traps, we ought to keep in mind that this method has it's own limitations, which cannot be excluded The following sources of possible errors must be mentioned

Resident animals could be captured everywhere within their home range and, therefore, we receive only limited information about their distribution The quality of this information depends on home size and individual spaciotemporal activity of the animal However, these variables are affected by many factors, as for example habitat, season, density etc (Mazurkiewicz 1971, 1983, Bondrup-Nielsen & Karlson 1985) Also the presence of migrants (Bashenina & Okulova 1981, Petrusewicz 1983, Bondrup-Nielsen 1985), which cannot be simply recognized among residents without using additional marking procedures (e g live traps or prebaiting - Holišova 1968), may devalue results Rearrangement of social organisation is usually reported from the period prior to the onset of breeding (Kikkawa 1964, Gliwicz & Rajska-Jurgiel 1983), that is why we decided to collect our sample in the period after the beginning of the breeding period On the other hand, even animals with established home ranges can display different trappability While trap-prone animals can be successfully captured during short-term trapping effort, trap-shy animals remain to be unrecognized (Andrzejewski et al 1971)

Behavioural responses to odour of previous animal captured to the trap may influence the final distribution of captured individuals It was reported that presence of male *A flavicollis* in double-trap caused lower probability of capture for *C glareolus* (Kalinowska 1971) The superiority of *A flavicollis* over *C glareolus* and *A sylvaticus* in the dominance rank was observed in behavioural experiments (Andrzejewski & Olszewski 1963, Montgomery 1978)

Factors mentioned above could produce errors which may to mask possible relationships Therefore, negative results must be evaluated carefully Composition of clusters of animals captured to the same or nearest neighbouring traps must be evaluated on the basis of present knowledge on their social and reproductive systems Exclusive territories are typical for female *C glareolus* Males home ranges are larger and overlapping territories of several females (Bujalska 1973, 1985, Viitala & Hoffmeyer 1985, etc ) Spatial distribution of males seems to be a result of the primary distribution of females in *Clethrionomys* species (*C rufocanus* Ims 1988) For *A flavicollis* only indirect information about their social and reproductive system is available In our material, several cases in which the male was captured in the proximity of a female and spaced by long distance from other pairs or individuals were present However, this finding is based on limited material and, therefore, additional data for f urther analysis of this phenomenon are needed

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# New records of Scarabaeoidea (Coleoptera) from Bulgaria

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**Faunistics, distribution, Scarabaeoidea, Coleoptera, Bulgaria, Balkan peninsula, habitats**

**Abstract.** The survey of the distribution of 64 Bulgarian Scarabaeoid species (Coleoptera) is presented. 35 species of these are recorded from Bulgaria for the first time. According to our knowledge seven of these have not been reported from the Balkan peninsula up to the present time: *Trypocopris fulgidus* (Motschulsky), *Cheironitis haroldi* (Ballion), *Onthophagus angorensis* Petrovitz, *Aphodius citellorum* Semenov & Medvedev, *A. rotundangulus* Reitter, *A. fumigatulus* Reitter and *A. sculpturatus* Reitter. All records from Bulgaria available were summarized for each species under study. Some details on biotops and habitats are mentioned.

The results of the study of an extensive but rich material of Scarabaeoid beetles collected by the authors and by many other predominantly Czech entomologists in Bulgaria during recent years are given. Only the species recorded for the first time from Bulgaria, the rare species and the species remarkable from the zoogeographical point of view are mentioned and discussed here.

The known distribution in the Balkan peninsula (Albania, Bulgaria, Greece, former Jugoslavia, European Turkey) of each species under study was compiled on the basis of lists and monographs available summarizing most the published records (Balthasar 1963, 1964, Horion 1958, Mikšic 1955, 1956, 1958a, 1958b, 1959, 1962, 1965, 1970, 1971, Petrovitz 1969, Schulze 1963), of catalogues (Machatschke 1972, Reitter 1906, Winkler 1927-32) and also of data in the literature lacking in the above studies (omitted or latter records).

The classification on the family level was taken over from Crowson (1981). The subgenera classification in the genus *Aphodius* Illiger is very complicated and non-uniform at the present time (see e.g. Balthasar 1964, Dellacasa 1988 and Nikolajev 1987). In this paper the authors used more or less common concept (e.g. Balthasar 1964, Mikšic 1970) but the subgenera are admitted by the authors as "working groups".

The international standard was used for the transliteration from the Cyrillic characters into the Roman characters.

In the text the following abbreviations were used:
alt. - above sea level altitude, Mt(s). Mountain(s), nr. - near, vill. - village, env. - environments.
C, N, S, W, E - Central, North, South, West, East.
± - more or less.
lgt. - collected by, det. - determined by, coll. - collection of (not collector!), rev. - determination revised by, K - Král, M - Malý (e.g.: M lgt. - collected by Malý, only M - Malý lgt. det. and coll.
*- first record from Bulgaria, ME - material examined, D - distribution in the Balkan peninsula, A - Albania, B - - Bulgaria, G - Greece, J - fromer Jugoslavia, T - European Turkey, N - note.
x/x - males/females, spec. - specimen(s).

LIST OF LOCALITIES (see map in Fig. 1)

1 Achtopol (town), alt. <100m. 1974 9-16 VII, K, 1976 3 VI, M
2 Ajtos (town), S foot of the ridge Ajtoska planina, E Stara planina Mts., alt. <100 m. 1976 V, M, 1982 27 IV, K.
3 Arkutino (deciduous lowland forest along the estuary of the river Ropotamo and its environs), alt. <150m. 1973 VII, D. Kantardžiev lgt., coll., M. det., 1974a VI, M, 1974b VI, J. Picka lgt., M. det., coll., 1976 VI, M, 1977 VI-VII, M, 1978 VII, M, 1982 1 V, K, 1983 9-10 V, K, 1984 3-6 VII, K
4 Asenovgrad (town), N foot of C. Rodopi Mts., alt. 200-500m. 1981 17 VII, K.
5 Bačkovo (monastery), C. Rodopi Mts., alt. 300-500m. 1974 7 VII, K, 1975 24 VI, K, 1981 14-16 VII, K, 1984 20-21 VI, K.
6 Balčik (town), alt. ±100m. 1982 20-21 VII, V. Kubaň lgt., K. det., coll.
7 Banderica (tourist hut), N. Pirin Mts., alt. ±1800m. 1987 9 VII, K.
8 Batovo (vill.), nr. Balčik, alt. ±100m. 1987 8-9 VII, O. Hovorka lgt., K. det., coll.
9 Begovica (tourist hut), S. Pirin Mts., alt. ±1800m. 1973 VI, M, 1979 17 VII, K, 1983a VII, S. Pokorný lgt., det., coll., K. rev, 1983b 17-18 VIII, K, 1986 4 V, K.
10 *Belite Brezi (tourist hut), the ridge Žalu djal, E. Rodopi Mts., alt. ±500m.* 1976 10-15 VI, B. Zvarič lgt., det., coll., K+M. rev.
11 Biser (vill.), nr. Charmanli, alt. ±100m. 1981 11-13 V, K.
12 Bomarevo (vill.), nr. Radomir, alt. ±700m. 1986 9 V, K.
13 Bosna (hills) nr. Mičurin, alt. ±200m. 1986 18-24 VII, J. Kolibač lgt., coll., K. det., coll.
14 Božura (tourist hut), nr. Grudovo, alt. ±150m. 1982 7-13 VII, V. Vohralík lgt., coll., K. det., coll.
15 Brodilovo (vill.), nr. Mičurin, alt. <150m. 1979 13 IV, L. Mencl lgt., det., coll., M. coll., rev.
16 Charmanli (town), alt. ±100m. 1974 24 VI - 1 VII, K. 1975 26-29 VI, K.
17 Chaskovo (town), alt. 100-200m. 1985 3 VI, M. & S. Pokorny lgt., det., coll., K. rev.
18 Čepelare (vill.), C. Rodopi Mts., alt. ±1100m. 1968 VII, R. Vesely lgt., K. det. coll., 1978 27 V, L. Mencl lgt., det., coll., S. Pokorny coll., K. rev.
19 Černomorec (vill.), nr. Sozopol, alt. <50m. 1978 IX, J. Tuček lgt., M. det., coll.
20 Damjanica (vill.), nr. Sandanski, alt. ±100m. 1984 V, S. Pokorny lgt., det., coll., K. rev.
21 Dabovo (railway station), S. foot of the ridge Trevnenska planina, C. Stara planina Mts., alt. 300-400m. 1983 5 V, K.
22 Daskotna (vill.), W. foot of the ridge Kamčijska planina, E. Stara planina Mts., alt. ±400m. 1983 25-29 VIII, K.
23 Dobrostan (ridge) C. Rodopi Mts., alt. ±1400m. 1981 15 VII, K, 1984 21 VI, K.
24 Dolna Dikanja (vill.), SW. foot of the ridge Golo bardo, alt. ±700m. 1975 17 VI, K.
25 Dospat (town), C. Rodopi Mts., alt. ±1000m. 1987 10 VII, K.
26 General Toševo (town), the Dobrudžansko plato (plateau), alt. ±200m. 1982 27 IV, K.
27 Ginci (vill.), S. foot of the ridge Berkovska planina, W. Stara planina Mts., alt. ±1200m. 1987. 2. VII., K.
28 Goljam Persenk (Mt.), the ridge Čematica, C. Rodopi Mts., alt. 1600-2000m. 1984 29 VI, K.
29 Gorna Orjachovica (town), alt. 100-200m. 1981 10 V, K.
30 Izgrev (vill.), nr. Mičurin, alt. ±100m. 1976 13 VI, M.
31 Jasna Poljana (vill.), nr. Prumorsko, alt. ±100m. 1976 2 VI, M, 1988 22 VII, J. Janata lgt., K. det., coll.
32 Kamčija (vill.) S. foot of the ridge Varbiška planina, E. Stara planina Mts., alt. 200-400m. 1981 15 V, K.
33 Kašina (vill.), nr. Melnik, SW. foot of the Pirin Mts., alt. 600-700m. 1983 21-22 VIII, K.
34 Kopitoto (*env. of tourist hut*) *N. Vitoša Mts., alt. 1600-1800m.* 1986 19-24 VI, M.
35 Kožuch (solitary limestone hill), nr. Petrič, alt. 100-200m. 1979 20-29 VIII, K.
36 Kraymore (vill.), nr. Burgas, alt. <50m. 1979 7 IV, L. Mencl lgt., det., coll., K. rev., coll.
37 Kranevo (vill.), nr. Balčik, alt. 50-100m. 1972 VI, J. Šulc lgt., K. det., M. coll.
38 Kresna (vill.), W. foot of the Pirin Mts., alt. 200-600m. 1978 24-30 V, K. Majer lgt., coll., M. det., coll., 1979a 7-12 V, J. Rybníček lgt., M. det., coll., 1979b 12-19 V, M. Kocourek lgt., K. det., coll., 1983a. 9 V, Z.

Kačenka lgt , K det , coll, 1983b VI , J Kalab lgt , det., coll , K+M rev , coll, 1985 1 -2 VI , M & S Pokorny lgt., det., coll , K rev

39 Lebnica (vill ), E foot of the ridge Ograždеn, alt 100 500m 1975 20 VI , K, 1979 18 -19 VIII , K, 1986 30 IV - 3 V , K, 1987 5 -7 VII , K, 1988 V , J Mička lgt , coll , K det coll

40 Liljanovo (vill ), S Pirin Mts , alt 400-600m 1979 14 -17 VIII K, 1983 VII M Soukup lgt , K det , M coll, 1986 3 5 V , K, 1987 6 VII , K

41 Lešnikovo (vill ), nr Charmanli alt ±100m 1971 VI J Čihař lgt , M det , coll

42 Lozenec (vill ), nr Mičurin, alt <50m 1975a 29 VI - 6 VII K 1975b 29 VI - 6 VII , J Vitner lgt , det , coll , K rev, 1981 21 VII , K, 1983 V , M, 1984 20 -30 VIII , M, 1986 VI , M

43 Manastir (vill ), NW foot of the ridge Prespanski djal, C Rodopi Mts , alt 1600-1900m 1981 17 -19 VII , K.

44 Melnik (town), SW foot of the Pirin Mts , alt 400 500m 1984 12 V , J Doskočil & S Pokorny lgt , det , coll , K rev

45 Mičurin (town) alt <50m 1975 VI , D Kantardžiev lgt., coll , M det, 1981 V , J Březina lgt , M det , coll, 1982 29 -30 VI , S Bílý lgt , det , coll K rev

46 Momčilgrad (town), E Rodopi Mts , alt ±300m 1978 VIII , J Flegr lgt., K det , coll

47 Mostovo (vill ), C Rodopi Mts , alt 700-900m 1987 13 -15 VII , K.

48 Nesebar (town), alt <50m 1966 VII , A Svozil lgt , M det , coll

49 Pamporovo (tourist resort), the ridge Bukova planina, C Rodopi Mts , alt 1300 1600m 1974 3 -7 VII , K.

50 Pirin (tourist hut), S Pirin Mts , alt 1600 1800m 1983 19 VIII , K

51 Prespa (Mt ) the ridge Prespanski djal C Rodopi Mts , alt 1800 1900m 1984 25 -26 VI , K

52 Primorsko (town), alt <50m 1966 VI , Trdlicova lgt , S Pokorny det. coll , K+M rev, 1980 VII , S Pokorny lgt., det., coll K+M rev, 1986 13 -15 VII , J Růžička lgt , K det , coll

53 Rakovo (vill ), N foot of the ridge Slivenska planina F Stara planina Mts , alt ±600m 1986 30 VI , S Kadlec & J Voříšek lgt , K det coll

54 Ravadinovo (vill ), nr Sozopol, alt ±50m 1985 19 27 VII , Z Černy lgt , K det , coll

55 Rogačevo (vill ), nr Balčik, alt ±100m 1981 9 12 VII , K

56 Rusalka (camping) nr Kavarna, alt ±50m 1975 10 VII , K

57 Ruse (town), alt ±50m 1981 17 V , K

58 Sandanski (town), W foot of the Pirin Mts , alt ±200m 1967 VI , A Svozil lgt , M det , coll, 1971 12 VII , K, 1973a VI , M, 1973b 28 VI , J Horak lgt , coll , M det, 1979 9 V , J Rybníček lgt M Rakovič det , J Víša coll , K+M rev

59 Simitli (vill ), W foot of the ridge Vlachina planina, alt ±300m 1982 25 VII , P Štorch lgt , M det , coll

60 Sklave (vill ), nr Melnik, SW foot of the Pirin Mts , alt 200-300m 1984 V , S Pokorny lgt , det coll , K rev

61 Slančev Brjag (sea side summer resort), alt <50m 1979 10 VI M Hradsky lgt coll , M det

62 Sozopol (town), alt <100m 1965 VIII , J Kral lgt K det , coll 1969 VI - VII , A Olexa lgt , coll , K det, 1971a VII , J Filip lgt., M det , coll, 1971b 3 VII , K, 1972 12 19 VII , J Nosek lgt , K det , coll, 1978a 15 25 VI , J Kondler lgt K det , coll, 1978b 2 IX , A Hoffer lgt. K det coll, 1979 15 IV , L Mencl lgt , M det , coll, 1982 28 IV - 4 V , K, 1983 6 -15 V , K, 1985 23 VI Z Černy lgt , K det , coll

63 Stara Kresna (vill ), W foot of the Pirin Mts , alt 200 600m 1987 3 -4 VII , K.

64 Strumjani (vill.), W foot of the Pirin Mts , alt ±100m 1986 8 V , K

65 Svoge (vill ), NW foot of the ridge Mala planina W Stara planina Mts , alt 600 700m 1986 22 VI , M

66 Škorpilovci (vill ), nr Georgi Trajkov, alt <50m 1983 VII , S Pokorny lgt , det coll , K rev

67 Šumen (town), alt ±200m 1914 Hanuš lgt , M det., coll

68 Tevno ezero (mountain lake), the Pirin Mts , alt ±2400m 1983 18 VIII , K.

69 Tjulenovo (vill ), nr Šabla, alt <50m 1984 12 VII , J Růžička lgt , K det , coll

70 Tremošnica (solitary building), SW Pirin Mts , alt ±1700m 1979 16 VIII , K, 1986 4 V , K

71 Trešteník (tourist hut) the Rila Mts , alt ±1700m 1985 2 VI M

72 Vidin (town), alt <50m 1975 16 VI , K

73 Vichren (Mt ), the Pirin Mts , alt ±2000m 1972 20 VII , R Rous lgt , M det , coll

74. Vodnjanci (vill.) nr. Belogradčik, alt. 200-300m. 1987: 2. vii., K.
75. Vlachi (vill.), W foot of the Pirin Mts., alt. ±500m. 1986: 6. v., K.
76. Vitoša (Mts.), alt. ±1500m (without more precise data). 1963: 12. vi., J. Král lgt., K det., coll.

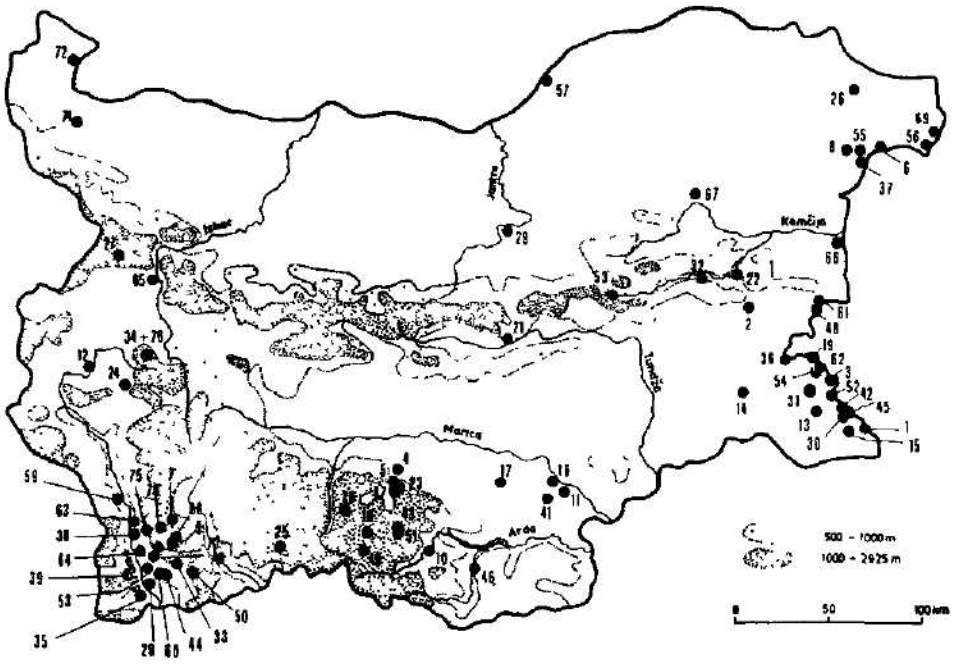


Fig. 1. Sketch-map of Bulgaria with the survey of the localities visited. (No 1-76 see List of localities).

## SURVEY OF SPECIES

### Lucanidae

* *Dorcus peyroni* Reiche, 1856

ME: Lebnica 1979 - 2 spec., in flight at about 10 p.m., old grove of *Platanus orientalis*; 1986, 1987 - rests of 2 resp. 1 spec., rotten trunk of *P. orientalis*; Momčilgrad - 1 spec.; Sandanski 1973a - 1/0; Simitli - 1/0.
D: G (Hellmann (1985) - recent record from Greek Macedonia).

* *Aesalus scarabaeoides* (Panzer, 1974)

ME: Arkutino 1983 - 2 spec., rotten stump of *Quercus*, margin of flooded plain forest
D: J, T.

### Trogidae

*Glaresis rufa* Erichson, 1848

ME: Charmanli 1974, 1975 - about 80 spec., at light in the camping south of the town, the species lives there in shore sand of the river Marica; Sozopol 1969 - more spec., at light, seashore dunes
D: J and B - only one record by Gottwald (1966) without precise data. Confirmed occurrence in Bulgaria.

### Geotrupidae

*Bolbelasmus unicornis* (Schrank, 1789)

ME: Mičurin 1982 - 1/0, at light; Šumen - 2/0.

D: J, G and B - only old records from Razgrad (Markovič 1909) and from Caribrod and Pleven (Nedjalkov 1905). Confirmed occurrence in Bulgaria.

*Trypocopris amedei* (Faimaire, 1855).

ME: Arkutino 1974a, 1977, 1978 - 5/3, 1/2, 2/2, humid deciduous forest, pitfall traps.

D: G, T and B - only one old record from Kalovo (the Strandža Mts.) by Tesař (1935). Confirmed occurrence in Bulgaria.

**Trypocopris fulgidus* (Motschulsky, 1845)

ME: Bosna - more spec., clear deciduous forest; Božura - 2/0; Mičurin 1975, 1981 - 1 spec. resp. 0/1.

D: First record from the Balkan peninsula, hitherto reliably recorded from Turkey only.

N: This species is closely related to *T. caspicus* (Motschulsky) and *T. vernalis* (Linnaeus), as a separate species was differentiated only recently (Zunino 1975).

*Thorectes punctulatus* (Jekel, 1865)

ME: Kopitoto - about 30 spec., deciduous less frequently in coniferous forest, after a heavy rain just on a pathway; Vichren - more spec.; Vitoša - 1/0.

D: J and B - recorded from the Rodopi Mts., the Stara planina Mts. and the Vitoša Mts. (Angelov 1965), by Mikšic (1959) without precise data and from Kostenec and the Rila Mts. by Tesař (1935). First record from the Pirin Mts.

N: Rare species, secretive in its habitat. The population from the Rila Mts. was described as *T. punctulatus rhilensis* Tesař. It is possible that the specimens from the Pirin Mts. and from the Vitoša Mts. concern this subspecies but for answering this problem it is necessary to have enough material from the whole area of occurrence.

## Hybosoridae.

*Chaetonyx robustus* Schaum, 1862

ME: Liljanovo 1979, 1986 - 1/1 and 0/1, under stones, pasture Treštenik - 1 spec., under stone.

D: A, J, G, T and B - only record without precise data by Mikšic (1959) and old records from Kurubaglar and Murgaš by Joakimov (1904) that can concern also other species (see Note bellow). Confirmed occurrence in Bulgaria.

N: Saprophagus, flightless species which is probably much more abundant than the records would indicate but it is secretive in its habitat. Old records from the Balkan peninsula can also concern the species *Ch. binaghii* Mariani and *Ch. schatzmayri* Mariani.

*Chaetonyx schatzmayri* Mariani, 1946

ME: Arkutino 1976 - about 30 spec., under great stone in decaying rests of plants; 1977 - 2 spec.; Bačkovo 1975, 1984 - 1/0 and 0/1, under stones, pasture; Mostovo - 1/0, under stone, deciduous forest; Lozenec 1975 - 0/1, in roots of *Cyclamen* sp

D: G (was described from Greek Macedonia - Vardar) and B - only one record by Mikšic (1959) without precise data. Confirmed occurrence in Bulgaria.

N: see *Ch. robustus* Schaum.

## Glaphyridae

*Eulasia bicolor* (Waltl, 1838)

ME: Biser - more spec., on yellow flowers of Asteraceae, clear deciduous forest.

D: J, G, T and B - only one record from Charmanli by Kantardžieva-Minkova (1959), repeated by Zacharieva (1965b).

## Scarabaeidae

*Scarabaeus armeniacus* Ménétriés, 1832

ME: Bomarevo - 1 spec , horse dung, pasture; Dolna Dikanja - 1 spec., sheep dung, pasture; Liljanovo 1986 - 1/1 sheep dung, pasture; Melnik - 0/1.

D: J, T and B - recorded from Ognjanovo (the Rodopi Mts.), Kurilo, Kjustendil and the Golo bardo ridge by Angelov (1965), from the Alibotusch Mts. by Csiki (1943), from Dragoman, Pazardžik and the Alibotuš Mts. by Pittioni (1940), from the environs of Pazardžik by Zacharieva (1965b) and from the environs of Petrič by Zacharieva & Dimova (1980).

N: All above records were published under the name *S puncticollis* Latreille which occurs in the western part of the Mediterranean area. *S armeniacus* Ménétriés was separated as a good species by Zu Strassen (1967) and occurs in the eastern part of the Mediterranean area including the Balkan peninsula.

* *Cheironitis haroldi* (Ballion, 1870)

ME Ajtos 1976 - 1/1, cow dung, pasture, Nesebar - more spec , Sandanski 1967 - more spec

D First record from the Balkan peninsula, Cyprus is the nearest known finding-place of this species (Balthasar 1963)

*Cheironitis ungaricus* (Herbst, 1789)

ME Lebnica 1987 - 1/3, horse dung, pasture, Sozopol 1971b - 1/0, cow dung, pasture

D J, G, T and B - recorded from the eastern part of the Rodopi Mts by Zacharieva (1965a), from Meden buk (the Rodopi Mts ) by Zacharieva & Dimova (1975), from Lozenec by Zacharieva et al (1975) and from the environs of Petrič by Zacharieva & Dimova (1980)

* *Caccobius mundus* (Ménetriés, 1838)

ME Achtopol 1976 - 15/18, sheep dung, pasture

D G T Common species in Turkey reaching the Bulgarian territory along the Black Sea cost.

* *Onthophagus angorensis* Petrovitz, 1962

ME Kožuch - 1/0, sheep dung, pasture, Krajmore - more spec

D First record from the Balkan peninsula, according to Binaghi et al (1969) known only from the locus classicus (Anatolia)

*Onthophagus atramentarius* Ménétriés, 1832

ME Lebnica 1979, 1986, 1987 - more spec , sheep, horse and pig dung, mostly on humid pastures

D J, G, T and B - recorded from Ljulin by Angelov (1965), from the environs of Petrovič by Zacharieva & Dimova (1980) and also by Balthasar (1963) without precise data

* *Onthophagus dellacassai* Pittino & Mariani, 1981

ME Arkutino 1974a - 2/2, 1976 more spec , deer dung, deciduous forest, 1982 - 0/1, in flight, 1983 - 3/2, under carrion of *Buteo buteo*, Kašina - 2/0, sheep dung, pasture, Lebnica 1986 - more spec , sheep dung, deciduous forest, 1987 - 0/1, under stone, pasture

D A, G (Martin-Piera & Zunino 1986), from Albania recorded also under the name *O panici* Petrovitz by Binaghi et al (1969)

*Onthophagus marginalis* Gebler, 1817

ME Lebnica 1979, 1987 - more spec , sheep and horse dung, humid pastures D J, G and B - recorded from Meden Buk (the Rodopi Mts ) by Zacharieva & Dimova (1975) and from the environs of Petrič by Zacharieva & Dimova (1980)

* *Onthophagus opacicollis* Reitter, 1892

ME Ajtos 1982 - more spec , sheep dung, pastures, Biser - more spec , sheep and horse dung, Charmanli 1974 - more spec , human excrement, camping, Primorsko 1/0, Sozopol 1971b, 1982, 1983 - more spec , sheep, cow and horse dung, togehter with the similar species *O fracticornis* (Preyssler)

D A, J, G, T

N: Described by Reitter as a variety of *O fracticornis* (Preyssler) and then once more by Pierotti as *O schatzmayri* (Mikšic 1971) Well differentiated from *O fracticornis* (Preyssler) and from *O similis* (Scriba) only by Balthasar & Hrubant (1960) Old records of *O fracticornis* (Preyssler) from Bulgaria (Nedjalkov 1909, Pittioni 1940) can in the fact concern these two closely related species.

*Onthophagus sericatus* Reitter, 1892

ME Achtopol 1976 more spec , Sozopol 1979 - more spec , 1982, 1983 - more spec , sheep and horse dung, *pastures mostly xerothermic exposed habitats The closely related species O verticicornis (Laicharting) occurs* here mostly in humid shaded habitats (mostly the vicinity of watering places under trees and shrubs).

D A, J, G and B - recorded from Kostenec and Germanski monastir by Pittioni (1940) and from the environs of Petrič by Zacharieva & Dimova (1980) First record from the Bulgarian Black Sea coast.

* *Aphodius (Ammoecius) brevis* Erichson, 1948

ME Mostovo - 1 spec , dry cow dung, shaded habitat near the entrance of the cave Erkjupju

D J

* *Aphodius (Erytus) aequalis* A. Schmidt, 1907

ME Balčik - more spec , at light

D G (Dellacasa 1973, Krell 1986)

N: Species secretive in its habitat, probably tied with seashore dunes.

* *Aphodius (Biralus) satellitus* (Herbst, 1789)

ME Achtopol 1976 - 1 spec , Chaskovo - 2 spec , Sozopol 1982, 1983 - more spec , fresh cow and sheep dung, pastures

D J, G

* *Aphodius (Limarus) maculatus* Sturm, 1800

ME Asenovgrad, Bačkovo 1974, 1975, 1981, Banderica, Dobrostan 1981, 1984, Goljam Persenk, Liljanovo 1979, Manastir, Pamporovo, Pirin - all these localities more spec , sheep or less horse or deer dung, almost exclusively forested areas or at least shaded habitats, Begovica 1973 - 4 spec , 1983 - 1 spec , Kašina 2 spec , human faeces, Škorpilovci - 1 spec

D J

* *Aphodius (Phalacronothus) biguttatus* Germar, 1824

ME Achtopol, 1976 - 4 spec , Ajtos 1976 - 1 spec , 1982 - more spec , sheep dung or buried in the openings of the burrows of *Citellus citellus* together with other species tied with this habitat [*Onthophagus semicornis* (Panzer) and *O vitulus* (Fabricius)], Biser - more spec , sheep or less cow dung, pastures, Damjanica - 2 spec , General Toševo - more spec , in the openings of the burrows of *Citellus citellus* or in sheep dung, pastures, Gorna Orjachovica - more spec , sheep dung, pastures, Kamčija - more spec , sheep dung, pastures, Liljanovo 1986 - more spec , sheep or horse dung, pastures, Melnik - 1 spec , Sozopol 1982, 1983 - more spec , sheep, horse or less cow dung, pastures, mostly exposed habitats

D J

* *Aphodius (Phalocronothus) citellorum* Semenov & Medvedev, 1928

ME General Toševo - 3/0, buried in the openings of the burrows of *Citellus citellus*, pasture at the old Turkish cemetery (for details see by *A rotundangulus* Reitter)

D First record from the Balkan peninsula, described from the Ukraine, known also from Austria, Hungary, Moravia, Slovakia and Roumania

N. Almost exclusively tied with the burrows of rodents

* *Aphodius (Phalacronothus) paracoenosus* Balthasar & Hrubant, 1960

ME Ajtos 1982, Bornarevo, Biser, Dabovo, General Toševo, Gorna Orjachovica, Lebnica 1986, Liljanovo 1986, Sozopol 1982, 1983 all these localities - more spec , mostly sheep, less frequently also horse and cow dung, pastures or forested areas, Arkutino 1977 - 1 spec , 1983 - 1 spec , excrement of *Sus scrofa*, deciduous forest, Begovica 1973 2 spec ; Ginci - 1/0, human excrement, Izgrev - 1 spec , Kamčija - 1/3, forest way, Kresna 1979a - 1 spec , Melnik - 2/0, Ruse 1/0, human excrement, Trešteník - 0/1

D G (Korfu Balthasar (1964))

N: Occurrence in the Balkan peninsula hitherto only deficiently known, in Bulgaria this species seems to be very common in the spring By the authors known also from Crna Gora and Greek Macedonia Bulgarian records of the closely related species *A (Ph ) coenosus* (Panzer) concern probably this species (Muche 1963, 1964, Zacharieva et al. 1975) since *A (Ph ) coenosus* (Panzer) is a West-European element.

*Aphodius (Nimbus) obliteratus* Panzer, 1823

ME Tremošnica 1986 - 1/1, old horse excrement from last autumn, just on the road

D J, G and B - recorded only once from the environs of Petrič by Zacharieva & Dimova (1980)

* *Aphodius (Melinoperus) pubescens* Sturm, 1800

ME Ajtos 1982, Gorna Orjachovica, Lebnica 1986, Vlachi - all these localities - more spec , sheep or horse dung, pastures, Melnik - more spec , Tremošnica 1986 - 2/0, fresh horse excrement, on the way

D A, J, G

* *Aphodius (Melinopterus) reyi* Reitter, 1892

ME Biser - about 30 spec , single horse excrement, shaded humid place, Lebnica 1986 - more spec , horse or less sheep dung, pastures, Liljanovo 1986 - more spec , single horse excrement just on the road,Tremošnica 1986 -

3/4, horse dung, pasture, Vlachi - 1/0, in flight
D First record from the Balkan peninsula, hitherto known from southwestern and Central Europe but also from Turkey

* *Aphodius (Melinopterus) sphacelatus* (Panzer, 1798)

ME Begovica 1986 - 1/0, *in flight at snow thawing*, Čepelare 1978 - *more spec*, Manastir - *more spec*, horse dung, pasture, Pamporovo horse, cow and sheep dung, pastures or also forested areas, Prespa - 3/2, sheep excrement, coniferous forest, Trešteník - 1 spec
D J, G

* *Aphodius (Trichonotulus) scrofa* (Fabricius, 1787)

ME Asenovgrad - 1 spec, dry sheep excrement under stone, pasture, Bačkovo - 1975, 1984 - more spec, sheep dung or deer dropings, open pasture or often also wooded areas, Biser; General Toševo, Gorna Orjachovica, Sozopol 1982, 1983 - all these localities - more spec, sheep dung, pastures, Ruse - 1 spec, in flight
D J, G

* *Aphodius (Orodaliscus) rotundangulus* Reitter, 1900

ME General Toševo - 1/1, buried in the openings of the burrows of *Citellus citellus*, pasture at old Turkish cemetery, together with further species tied with the burrows of small rodents (*Onthophagus semicornis* (Panzer), *O vitulus* (Fabricius), *Aphodius (Plagiogonus) putridus* (Fourcroy), *A (Phalacronothus) biguttatus* Germar and *A (Ph.) citellorum* Semenov & Medvedev), Rusalka - 1/0, dead in spider's web
D First record from the Balkan peninsula, hitherto known from the Ukraine, from Kazachstan under the name *A batesoni* Semenov & Medvedev and *A fortimargo* Reitter (synonymy according to Nikolajev (1987)), from Poland as *A makolskii* Roubal according to Dellacasa (1991) and from Roumania (Ienistea 1982)
N: The species is apparently confined to the burrows of rodents e g *Marmota bobac* (Ukraine), *Citellus suslicus* (Poland), *Citellus citellus* (Roumania)

*Aphodius (Esymus) fumigatulus* Reitter, 1892

ME Sandanski 1979 - 1 spec
D First record from the Balkan peninsula, described from Transcaucasia and also known from Asia Minor (Balthasar 1964)

* *Aphodius (Esymus) sculpturatus* Reitter, 1892

ME Lebnica 1986 - 1 spec, sheep dung, extremely xerothermic pasture with occurrence of *Galeodes* sp
D First record from the Balkan peninsula, known from Transcaucasia, Syria and Lebanon (Balthasar 1964)

* *Aphodius (Aphodius) frater* Mulsant, 1871

ME Kresna 1985 - 7/3, dry cow dung, pasture
D J (Velebit)
N: Species secretive in its habitat, almost exclusively saprophagous

*Aphodius (Loraphodius) suarius* Faldermann, 1835

ME Černomorec - 1 spec, Kamčija - 3 spec, in putrefied rests of plants, Lozenec 1984 - 74 spec, in the camping Oasis, probably attracted by smell of latrines, Tjulenovo - 1 spec
D G, J and B - recorded from Sultanlar by Horion (1958) and without precise data by Mikšic (1959) Confirmed occurrence in Bulgaria
N: Almost exclusively saprophagous species.

* *Aphodius (Agrilinus) borealis* Gyllenhal, 1827

ME Bačkovo 1974 - 2 spec, sheep excrement, clear deciduous forest, Begovica 1973 - 2 spec, Dospat - more spec, old dry cow dung, coniferous forest, Liljanovo 1986 - 1 spec, in flight, Manastir - 3 spec, sheep dung, coniferous forest, Mostovo - more spec, old humid cow excrement, shady habitat near the entrance of the cave Erkjupju
D J, G

* *Aphodius (Agrilinus) satyrus* Reitter, 1892

ME Banderica, Begovica 1973, 1979, 1983b, Goljam Persenk, Manastir; Pamporovo, Pirin, Prespa - all these localities more spec, sheep less cow dung, pastures and forested habitats, in the zone of coniferous forest frequent species, Tevno ezero - 2 spec, sheep dung, pasture above the border of coniferous forest zone.
D J (Velebit)

* *Aphodius (Agrilinus) vittatus* Say, 1825

ME Biser - 1 spec , sheep dung, pasture, Lebnica 1986 - about 50 spec., sheep dung, pastures

D G (Rhodos, by the authors known also from Cyclades)

* *Aphodius (Bodilus) ghardimaouensis* Balthasar, 1929

ME Charmanli 1974, 1975 - more spec , cow dung, sandy pasture on the bank of the river Marica.

D J, G (Rhodos)

* *Aphodius (Liothorax) kraatzi* Harold, 1868

ME Kožuch - more spec , horse dung, pasture, Sozopol 1972 - 1 spec , Vidin - more spec , at light, bank of the river Danube,

D A, J, G

*Euheptaulacus sus* (Herbst, 1783)

ME Bačkovo 1974, 1975, 1981 - more spec , in soil under dry sheep dung, xerothermic limestone pasture

D J, G and B - only one old record from Sofia by Joakimov (1904) Confirmed occurrence in Bulgaria.

*Psammodius asper* (Fabricius, 1775)

ME Daskotna - more spec , between roots of grasses in fine sand together with further psammophilous species (*Psammodius laevipennis* Costa, *Leiopsammodius strumae* (Chromý), *Rhyssemus germanus* (Linnaeus)), bank of the river Luda Kamčija, Lebnica 1986 - 3 spec , under dry rests of plants, sandy bank of the river Lebnica

D J and B - recorded only from Kresna by Chromy (1983)

*Psammodius basalis* Mulsant & Rey, 1871

ME. Arkutino 1974a, 1976, 1977 1978, Lozenes 1975, 1981, 1983, 1984, 1986, Sozopol 1978b - all these localities - between dry and humid sand, seashore dunes

D G and B - recorded only once from the environs of Sozopol (Mencl 1982)

*Leiopsammodius strumae* (Chromý, 1983)

ME Daskotna - 1 spec , between roots of grasses in fine sand, bank of the river Luda Kamčija (see also *P asper* (Fabricius)), Lebnica 1979 - 1 spec , under stone, sandy bank of the river Lebnica

D B - described from basin of the river Struma (Kresna, Sandanski), first recorded from the northern part of Bulgaria

N: This species is closely related to *L bellot* (Pierotti, 1981) which was described from Peloponnese and according to Rakovič (1986) is possibly identical with him

*Pleurophorus pannonicus* Petrovitz, 1961

ME Arkutino 1984 - 1 spec , in flight, seashore dunes, Charmanli 1974 - 1 spec , at light, in the camping south of the town, together with 783 specimens of the similar species *P caesus* (Creutzer), Rogačevo - 6 spec , at light

D J, G and B - recorded only from Varna by Pittino & Mariani (1986)

* *Maladera apfelbecki* Petrovitz, 1969

ME Lebnica 1975 - 1/1, on vegetation, sandy bank of the river Lebnica

D A, G

N: According to Petrovitz (1969) the species *Maladera punctatissima* (Faldermann) occurs in Transcaucasia and Anatolia and the records of this species from the Balkan peninsula (e g Miksic 1959) concern in the fact *M. apfelbecki* Petrovitz and two further species described from Greece.

*Miltotrogus fallax* (Marseul, 1879)

ME Biser - 0/1, dead under stone, clear oak forest, Kresna 1979a - more spec , Melnik - more spec

D A, J, G and B - recorded only from Belovo (the Rodopi Mts ) and Stalin [=Varna] by Kantardžieva-Minkova (1953), repeated by Nonveiller (1965) and Zachariева & Dimova (1975), without precise data recorded also by Mikšic (1959) and Petrovitz (1969) by the former author as questionable

* *Miltotrogus gradojevici* Nonveiller, 1965

ME Sozopol 1983 - 1/0, under stone, pasture

D G Hitherto known only from locus classicus (Thessaloniki and Port Baklar) (Nonveiller 1965, Petrovitz 1969)

*Miltotrogus pilicollis* (Gyllenhal in Schonherr, 1817)

ME Sozopol 1983 - 2/2, on the leaves of *Quercus* sp , right after the sunset, together with more specimens o *M vernus* (Germar) and *Rhizotrogus aestivus* (Olivier), sitting on the leaves or flying round

D A, G, J, T and B according to both the lists of Balkan Scarabaeoidea (Mikšic 1959, Petrovitz 1969) the occurrence in Bulgaria is questionable, although this species is recorded from Ruse and Stara planina (Nedjalkov 1905) and from Lakatnik, Sliven, Caribrod and the Strandža planina Mts by Kantardžieva-Minkova (1953), repeated also by Nonveiller (1965) Confirmed occurrence in Bulgaria

*Amphimallon altaicum* (Mannerheim in Hummel, 1825)

ME Batovo - 1/1, Kranevo - 2/1

D G (Panin 1955) and B - recorded from Ekrene [=Kranevo] also by Panin (1955), repeated by Zacharieva (1965b) and from Svilengrad (larvae!) by Zacharieva (1965b) According to Mikšic (1959) both the records by Panin (1955) are questionable and in the list of Balkan Scarabaeoidea (Petrovitz 1969) this species is lacking at all Confirmed occurrence in Bulgaria and in the Balkan peninsula

* *Amphimallon burmeisteri* Brenske, 1886

ME Bačkovo 1984 - 6/1, in flight round the solitary *Pinus* sp , after the sunset, Čepelare 1968 - 0/1, Liljanovo 1983 0/1, Manastir - 1/0, in flight, after the sunset on the road in the coniferous forest

D J

N: This species was separated from related *A assimile* (Herbst) only by Nonveiller (1959) on the basis not only of morphological features but also on difference in the time of flight, *A assimile* (Herbst) seems to be diurnal while *A burmeisteri* Brenske nocturnal species Some of records of *A assimile* (Herbst) from Bulgaria (Joakimov 1904, Kantardžieva-Minkova 1953, Nedjalkov 1905) probably concern this species

*Polyphylla boryi* (Brullé, 1832)

ME Sandanski 1973b - 2/0

D J, G and B - only two records without precise data (Mikšic 1959, Petrovitz 1969) Confirmed occurrence in Bulgaria

*Anisoplia aprica* Erichson, 1847

ME Sozopol 1965 - 1/0, Vodnjanci 1/0, on grasses, sandy basis

D G and B recorded from Knjaževo by Zacharieva (1951), from Kazanlak by Zacharieva (1962) and from the Rodopi Mts by Zacharieva & Dimova (1975)

* *Anisoplia dispar* Erichson, 1847

ME Arkutino 1984 - 3/1, on grasses, margin of the clear deciduous forest, Jasna Poljana 1988 - more spec , Lozenec 1975 - 0/1, 1985 - 1/0, elm wood-like steppe, Ravadinovo - 1/0, Sozopol 1978a - 3/2

D J (Medvedev 1949), G

*Hoplia brunnipes* Bonelli, 1807

ME Lebnica 1975 - 1/1, on grasses in the morning, sandy bank of the river Struma, Sandanski 1971 - 0/1, Stara Kresna - 0/1, under stone in fine sand, bank of the river Struma

D J, G, T and B - recorded only from Pazardžik by Nedjalkov (1909) under the name *H floralis* (Olivier), repeated also by Mikšic (1959) and without precise data by Petrovitz (1969) Confirmed occurrence in Bulgaria

* *Hoplia dilutipes* Reitter, 1890

ME Arkutino 1984 - 1/0, dead in spider's web, Primorsko 1966, 1980 - 1 and 1 spec , Rakovo - 0/1

D J

* *Hoplia stenolepis* Apfelbeck, 1908

ME Kresna 1979a - 6 spec , 1979b - more spec , Lebnica 1986 and Strumjani - both localities - more spec., on the branches and flowers of *Tamariscus* sp , the majority of specimens active in the morning at about 9 11 a.m , then buried in sand, Sklave - more spec

D A, J

*Propomacrus bimucronatus* (Pallas, 1781)

ME Arkutino 1973 - 1/0, old deciduous forest, in the night on a trunk, Sozopol 1971a - 3/0, Lebnica 1988 - 6 larvae and rests of 1 imago, in a hollow of *Platanus orientalis*

D J, G (Hellmann 1985, Luttgen 1983, Mašek 1985, Young 1989) and B - only one record from Primorsko (15 VIII 1975) by Mašek (1985)

N: Relict pontomediterranean species of lowland deciduous native forests worthy of a strong protection

*Gnorimus variabilis* (Linnaeus, 1758)

ME Arkutino 1978 - 0/1, in flight, Liljanovo 1983 - 1/0; Svoge - 2/2 and more larvae in an old rotten *Prunus*

D A, J, G and B - only two old records from Kazanlak by Nedjalkov (1905) and from Vratca by Nedjalkov (1909), repeated by Mikšic (1959) and without precise data by Schulze (1963) Confirmed occurrence in Bulgaria

*Protaetia angustata* (Germar, 1817)

ME Achtopol 1974 - 1 spec , Lešnikovo - 1 spec , Stara Kresna - 3 spec , on the flowers of *Onopordum*; Tremošnica 1979 - 2 spec , on the flowers of *Sambuccus ebulus*

D A, J, G, T and B - only one record from Demir Kapu by Mikšic (1987)

*Protaetia mirifica* (Mulsant, 1842)

ME Arkutino 1947b - 1 spec , 1978 - 0/1, on the oak trunk, Božura - 2 spec., on fruits, dust heap, Slančev Brjag - 0/1, in the camping Piknik, Stara Kresna rests of 1 spec , on the way

D A, J, G and B - only records from Varna (Tassi 1966, Mikšic 1987) and without precise data by Mikšic (1965) and Petrovitz (1969)

N: The all above records were published under the name *P koenigi balcanica* Mikšic, 1957 which is regarded according to Moreto & Baraud (1982) as a junior synonym of *P mirifica* (Mulsant).

* *Protaetia trojana* (Gory, 1933)

ME Kresna 1978, 1983, 1985 - more spec , almost exclusively on the flowers of thistles e g *Onopordum*, Lozenec 1975b - 1 spec

D G

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# Trematodes of the common cormorant (Phalacrocorax carbo) in Czech Republic

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**Abstract.** The present paper comprises a systematic survey of trematodes collected from 101 common cormorants, *Phalacrocorax carbo* (L.), in South Bohemia and South Moravia, Czech Republic, in 1987-1992. The following eleven species were recorded: *Petasiger exaeretus, P. phalacrocoracis, Paryphostomum radiatum, Metorchis xanthosomus, Heterophyes aequalis, Apophallus muehlingi, Galactosomum lacteum, Cercarioides aharonii, Phagicola longus, Holostephanus dubinini* and *Hysteromorpha triloba*. The species *H. aequalis, G. lacteum, P. longus* and *H. dubinini* are now reported for the first time from Central Europe. The common cormorant represents a new definitive host for heterophyid trematode *C. aharonii*. Most trematode species found are briefly described and illustrated and some problems concerning their taxonomy, hosts and geographical distribution are discussed.

## INTRODUCTION

Data concerning the helminth fauna of cormorants (*Phalacrocorax carbo* (L.)) from the region of former Czechoslovakia are rather scarce. Small numbers of these fish-eating birds were examined by Vojtěchovská-Mayerová (1952) and Ryšavý (1958) from one locality (Podunajské Biskupice) in southern Slovakia and only recently Moravec et al. (1988) and Moravec (1990) reported on the results of helminthological examinations of a few cormorants originating from South Bohemia and South Moravia. Only three species of trematodes, *Paryphostomum radiatum, Petasiger phalacrocoracis* (see Našincová et al., 1993a) and *Hysteromorpha triloba*, were recorded by the above mentioned authors.

In 1987-1992, during studies on the helminth parasites of cormorants, carried out by the Institute of Parasitology, ASCR, in České Budějovice, a total of one hundred and one cormorants were examined from South Bohemian and South Moravian localities. In them, in addition to other parasites, eleven species of trematodes were recorded. Since some of them are inadequately known or were not previously recorded from then Czechoslovakia or even from Europe, their taxonomic evaluation is the subject of this paper.

## MATERIALS AND METHODS

A total of 101 common cormorants, *Phalacrocorax carbo* (L.), from several localities on South Bohemia and South Moravia were helminthologically examined between 1987 and 1992. The trematodes found were fixed under slight pressure with 70% ethanol; after staining with borax carmine, they were dehydrated in an ethanol series and mounted in Canada balsam. Drawings were made with the aid of a Carl Zeiss drawing attachment. All measurements are in μm unless otherwise stated. Reference specimens are deposited in the helmithological collection of the Institute of Parasitology, Academy of Sciences of Czech Republic (ASCR), in České Budějovice.

## SURVEY OF SPECIES

### Family Echinostomatidae Loos, 1902

1. *Petasiger exaeretus* Dietz, 1909

Syn.: *Petasiger baschkirovi* Ablassov et Iksanov, 1959

Site: posterior part of small intestine.

Localities: South Moravia: pond Starý near Pohořelice - September 1989; ponds near Pohořelice - July 1991.

COMMENTS: The species has been dealt with in a separate paper by Našincová et al. (1993a). It has been found relatively rarely in cormorants from two South Moravian localities only. The intensity of infection was also rather low, ranging from 1 to 14 specimens in a bird.

2. *Petasiger phalacrocoracis* (Yamaguti, 1939)

Syn.: *Echinoparyphium phalacrocoracis* Yamaguti, 1939; *Petasiger hospitale* (Mendheim, 1940); *P. exaeretus* auctorum, nec Dietz, 1909.

Site: anterior part of small intestine.

Locality: South Bohemia: pond Staré jezero near Chlum u Třeboně - November 1987; pond Ženich near Stará Hlína - August 1989, July and August 1990, May 1991, May 1992; South Moravia: pond Prostřední near Lednice - September 1989; ponds near Jaroslavice - July 1991; Nové Mlýny water reservoir near the village of Dolní Věstonice - April and May 1992.

COMMENTS: The morphology of this species, that has erroneously been designated in the literature as *P. exaeretus*, as well as the differential diagnosis of *Petasiger* species parasitizing cormorants are described in a paper by Našincová et al. (1993a). This species is a very frequent parasite of the common cormorant in all localities studied and it occurs even in rather young birds. In most localities, the prevalence was considerably high, reaching often almost 100 % (Ženich pond, Jaroslavice, Nové Mlýny water reservoir). The intensity of infection was also very high (several hundreds of specimens).

3. *Paryphostomum radiatum* (Dujardin, 1845)

Syn.: *Echinochasmus tenuicollis* Johnston, 1917; *Paryphostomum phalacrocoracis* Goss, 1941.

Site: posterior part of small intestine.

Localities: South Bohemia: pond Staré jezero near Chlum u Třeboně - November 1987; pond Ženich near Stará Hlína - August 1989, July and August 1990; South Moravia: pond Prostřední near Lednice - September 1989; ponds near Jaroslavice - July 1991; Nové Mlýny water reservoir near the village of Dolní Věstonice - April and May 1992.

COMMENTS: The morphology of developmental stages of this trematode, including that of adult worms from cormorants, is described in detail in a separate paper by Našincová et al. (1993b). This species is a rather common parasite of the common cormorant both in South Bohemian and South Moravian localities. The prevalence was remarkably high in some localities (Staré jezero near Chlum u Třeboně, ponds around Pohořelice, pond Prostřední near Lednice), where its value reached 100 %; the intensity of infection was rather high as well, with maximum values (from 85 to 210) in South Moravia.

### Family Opisthorchiidae Braun, 1901

4. *Metorchis xanthosomus* (Creplin, 1846) Fig. 1 A

Syn.: *Metorchis pinguinicola* Skrjabin, 1913; *M. intermedius* Heinemann, 1937.

DESCRIPTION (14 specimens): Medium sized trematodes, forebody somewhat tapering, hindbody broader; length of body 1484 -2720 (2078), maximum width 372-960 (651). Body covered with fine spines. Oral sucker terminal, size 113-184 x 126-302 (181 x 217). Prepharynx absent. Pharynx small, 45-88 (55) long and 30-68 (39) wide. Oesophagus absent. Caeca terminating at posterior

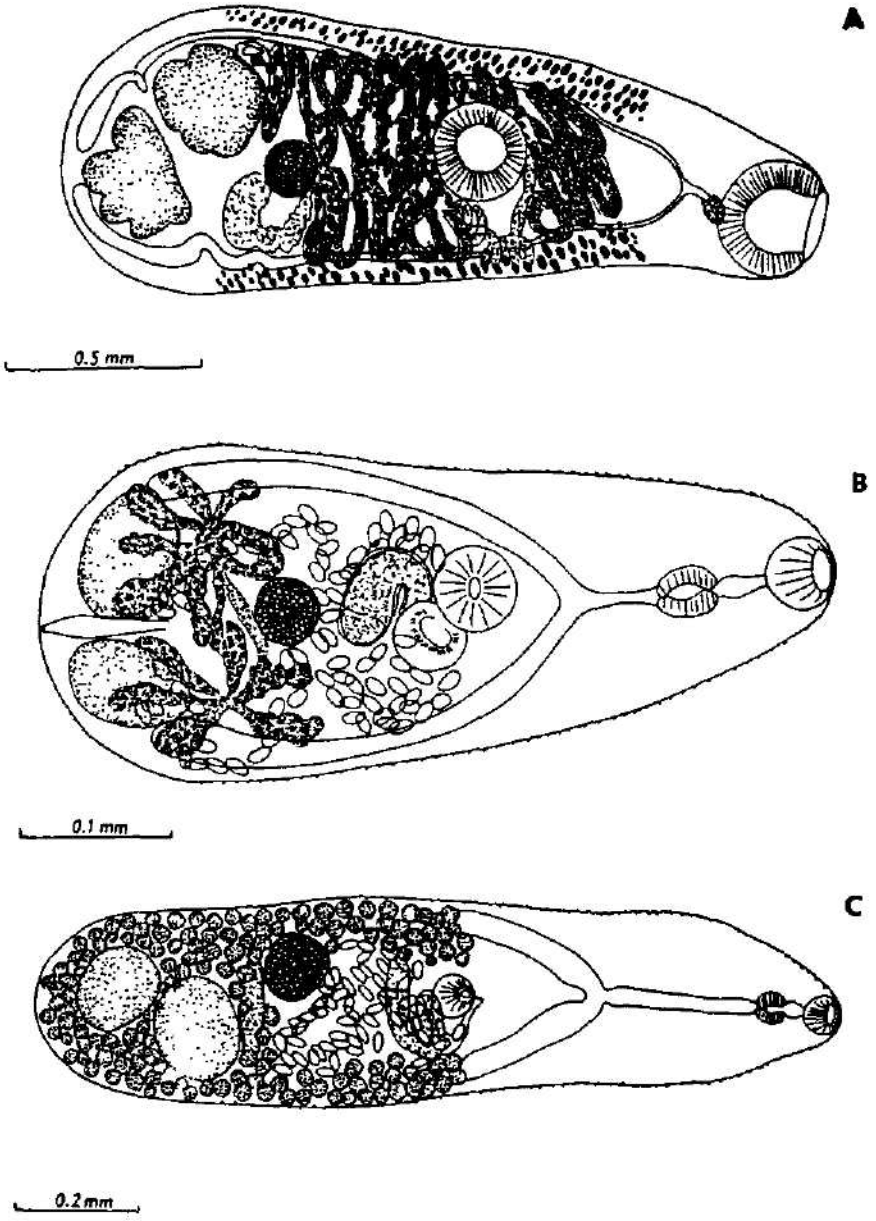



Fig. 1. A - *Metorchis xanthosomus* (Creplin, 1846); B - *Heterophyes aequalis* Looss, 1902; C - *Apophalus muehlingi* (Jagerskiold, 1899).

extremity Acetabulum situated near middle of body, usually being somewhat preequatorial, slightly smaller than oral sucker, measuring 130-260 x 155-255 (192 x 205) Testes diagonal, round or somewhat lobed, close to posterior extremity, anterior testis measuring 98-284 x 113-378 (208 x 271), posterior one 158-315 x 225-390 (237 x 311) Seminal vesicle tubular Genital pore just in front of acetabulum Ovary spherical, median or submedian, pretesticular, size 80-170 x 100-178 (111 x 126) Uterus winding forward from ovary approximately to level of anterior end of vitellaria Eggs numerous, oval, size 25-30 x 13-15 (27 x 14) Vitellaria extending in lateral fields from ovarian zone to beyond acetabulum, reaching almost level of intestinal bifurcation

Site gall-bladder

Localities South Bohemia ponds Novy Vdovec and Ženich near Stara Hlina July and August 1990, South Moravia ponds near Pohořelice July 1991, ponds near Jaroměřice July 1991 Nove Mlyny water reservoir near the village of Dolní Věstonice April 1992

COMMENTS The taxonomy of *Metorchis* species parasitizing birds in Europe is rather confused, this being mainly due to a considerable morphological variability of adult trematodes of this genus Odening (1962) synonymized the species *M crassiusculus* (Rudolphi, 1809), *M xanthosomus* (Creplin, 1846), *M pinguinicola* Skrjabin, 1913, *M intermedius* Heinemann, 1937 and *M coeruleus* Braun, 1902 with *Metorchis bilis* (Braun, 1790), but Vojtek (1981) and some other authors do not consider this synonymy to be well founded without knowledge of the life-cycles

The specimens of the present material exhibit a high degree of morphological variability, concerning mainly the shape of the body, the position and shape of the testes and the ovary, the position of the acetabulum and other features By their morphology they resemble *Metorchis xanthosomus* and *M intermedius*, the two species considered by Bykhovskaya-Pavlovskaya & Kulakova in Bauer (1987) to be identical, since the trematodes of the genus *Metorchis* recorded from European cormorants were also identified earlier either as *M. xanthosomus* or as *M intermedius* (see e g , Bykhovskaya-Pavlovskaya, 1962, Vyshkvartseva, 1969, Yamaguti, 1971), we consider our specimens to belong to *M xanthosomus* (syn *M intermedius*) According to Bykhovskaya-Pavlovskaya & Kulakova in Bauer (1987), *M xanthosomus* (Creplin, 1846) is parasitic in water birds, largely fish-eating birds, whereas *M bilis* Braun, 1790 (syn *M albidus* (Braun, 1898)is a parasite of predatory and carnivorous mammals

In then Czechoslovakia, *M xanthosomus* (including its synonyms *M intermedius* and *M pinguinicola*) has been reported only from *Fulica atra* from South Moravia and Slovakia (Vojtek & Vojtkova, 1961; Macko, 1969; Babička & Vojtek, 1972), also the trematodes reported as *M bilis* from *Anas platyrhynchos* from southern Slovakia (Macko, 1974) may be conspecific with *M xanthosomus* No *Metorchis* species were reported earlier from cormorants in Czechoslovakia (Vojtek, 1981) The present findings show that in the localities under study *M xanthosomus* is one of the less frequent helminth parasites of cormorants, the prevalence in adult cormorants from individual localities ranged from 8-33 %, with the intensity being 1-9 (mean 3) trematodes per bird

The only first intermediate host of this trematode is the prosobranchiate snail *Bithynia tentaculata* (Heinemann, 1937, Vyshkvartseva, 1969; Vojtek, 1974, 1976), while the second intermediate hosts are various fishes of the families Cyprinidae and Cobitidae (Heinemann, 1937; Vyshkvartseva, 1969, Yamaguti, 1975, Bykhovskaya-Pavlovskaya & Kulakova in Bauer 1987), Vojtek (1981) considers *Cobitis taenia* to be the only second intermediate host of *M intermedius* (= *M xanthosomus*) In former Czechoslovakia, larval stages of this trematode species (reported as *M intermedius*), cercariae from *B tentaculata* and metacercariae from *C taenia*, have so far been reported by Vojtek (1961, 1974 1976) and Par & Vojtek (1972) from southern Slovakia The metacercariae of *M xanthosomus* are found in thick-walled spherical cysts located in the musculature and gills of infected fishes (Yamaguti, 1975, Bykhovskaya-Pavlovskaya & Kulako-

va in Bauer 1987)

## Family Heterophyidae Odhner, 1914

5 *Heterophyes aequalis* Looss, 1902 Fig 1B

DESCRIPTION (10 specimens) Small sized trematodes, 447-672 (545) long and 170-233 (197) wide Body surface covered with tegumental spines Oral sucker subterminal, measuring 33-45 x 43-56 (41 x 49) Prepharynx present, relatively long, only slightly shorter than oesophagus; pharynx oval, 30-38 x 22-32 (33 x 28) in size Caeca reaching posteriorly to level of anterior margin of testes Ventral sucker slightly prequatorial, measuring 49-65 x 52-63 (56 x 58). Genital sucker lying obliquely behind acetabulum, armed with 17-28 small spines arranged in incomplete circle, size of genital sucker 37-52 x 38-60 (40 x 44) Testes oval, situated symmetrically near posterior extremity, size of left testis 52-100 x 30-70 (79 x 54), that of right testis 60-107 x 45-75 (81 x 58) Seminal vesicle large, bent toward genital sucker Ovary pretesticular, measuring 40-60 x 37-54 (49-46) Vitellaria situated between ovary and posterior margins of testes, grouped into about 12-16 follicles Uterus formed by several loops lying mostly intracaecally and postequatorially Eggs oval, measuring 20-23 x 13-15 (22 x 14) Excretory bladder I-shaped

Site posterior part of small intestine

Locality South Moravia Nove Mlyny water reservoir near the village of Dolni Věstonice April 1992

COMMENTS The morphology of trematodes from the common cormorant clearly indicates that they belong to the genus *Heterophyes* Cobbold, 1866 The trematodes studied are typified, among others, by small number of spines on the genital sucker (17-28), caeca reaching posteriorly only near anterior margin of testes, and small body On the basis of these characteristics, the specimens under study well correspond to the species diagnosis of *H aequalis* as given by Morozov (1952), Reimer (1969) and Taraschewski (1984)

*H aequalis* adults have hitherto been found in carnivores (domestic cat, dog) and predatory or fish-eating birds (*Milvus aegyptiacus, Pelecanus onocrotalus, Larus ridibundus, Chlidonias leucoptera*) from Tunisia, Egypt, Israel, Saudi Arabia and Azerbaidzhan (Morozov, 1952; Yamaguti, 1971, Taraschewski & Nicolaidou, 1987) Reimer (1969) found this trematode species in the common cormorant from the former East Germany On the basis of feeding experiments with 16 potential mammalian and bird definitive hosts, Taraschewski (1985) concluded that *H aequalis* has relatively wide range of hosts According to Taraschewski (1987), human infections with this heterophyid trematode are very probable

Recent findings of *H aequalis* larval stages in the mud snail, *Pirenella conica* (family Potamididae), published by Taraschewski & Nicolaidou (1987), give evidence about the current occurrence and development of this trematode in Europe Consequently, the present record of *H aequalis* adults in South Moravia, together with previous report of its occurrence in East Germany by Reimer (1969), confirms this fact Nevertheless, the life cycle of *H aequalis* can hardly be completed in Central Europe, because the first intermediate host, the snail *Pirenella conica*, is euryhaline and it seems to occur in Europe only in a limited number of localities of the Mediterranean coast, mainly in Greece (Taraschewski & Nicolaidou, 1987) It can be supposed that the cormorant, harbouring *H aequalis* trematodes, became infected outside of Czechoslovakia or even outside Europe

Taraschewski (1987) stated that *H aequalis* preferred posterior part of the small intestine (ileum, posterior jejunum) as the site of its localization in the definite hosts *H aequalis* trematodes found in the common cormorant from South Moravia were also localized in posterior part of the small intestine

In the present study, only one cormorant was found to harbour this species (intensity of

infection 680 specimens).

6. *Apophalus muehlingi* (Jagerskiöld, 1899) Fig. 1 C

Syn.: *Mesorchis oesophagolongus* Katsurada, 1914.

DESCRIPTION (5 specimens): Body elongate, 1136-1984 (1395) long and 284-378 (330) wide. Body surface covered with spines, larger anteriorly. Oral sucker nearly terminal, 45-55 (50) x 53-68 (59) in diameter. Prepharynx short; pharynx measuring 43-50 (46) x 35-50 (44). Oesophagus considerably long; caeca reaching posterior extremity. Ventral sucker muscular, only slightly modified; size of sucker 50-75 (61) x 53-77 (64). Genital pore lying close to anterior margin of acetabulum; genital atrium formed by two unarmed semispherical papillae (gonotyl). Testes large, slightly oblique, located near posterior extremity; size of anterior testis 78-164 (139) x 103-214 (157), that of posterior one 103-175 (144) x 105-190 (157). Seminal vesicle strongly curved, two-chambered; proximal chamber elongate, distal oval. Ovary rounded, submedian, pretesticular; its size 75-108 x 90-132 (90 x 119). Seminal receptacle transversaly elongate, lying between ovary and anterior testis. Vitelline follicies numerous, situated laterally between ventral sucker and ovary, filling almost entire testicular region of body and forming large group of follicles near posterior extremity. Uterus tubular, filled with eggs measuring 37-40 (38) x 17-21 (19).

Site: posterior part of small intestine.

Locality: South Moravia: Nové Mlýny water reservoir near the village of Dolní Věstonice - April 1991; May 1992.

COMMENTS: The specimens from the common cormorant correspond well in their morphology to those of *A. muehlingi* described. e.g., in papers by Morozov (1952), Vojtek (1959) and Bykhovskaya-Pavlovskaya (1962). This trematode species is a common parasite of mammals (dogs, cats) and particularly of predatory or fish-eating birds of the orders Pelecaniformes, Ardeiformes, Lariformes, Charadriiformes and Falconiformes, including cormorants in Europe and Asia (Morozov, 1952; Yamaguti, 1971). The common cormorant, *Phalacrocorax carbo*, has also been reported as the definitive host of *A. muehlingi* in then USSR and Yugoslavia (Serbia) Bykhovskaya-Pavlovskaya, 1962; Kiškaroly & Tafro, 1988). Metacercariae of this trematode encysted in the flesh and fins of fish, especially in cyprinids (e.g. in *Abramis brama, Blicca bjoerkna, Rutilus rutilus, Scardinius erythrophthalmus, Rhodeus sericeus*) (Morozov, 1952; Yamaguti, 1975).

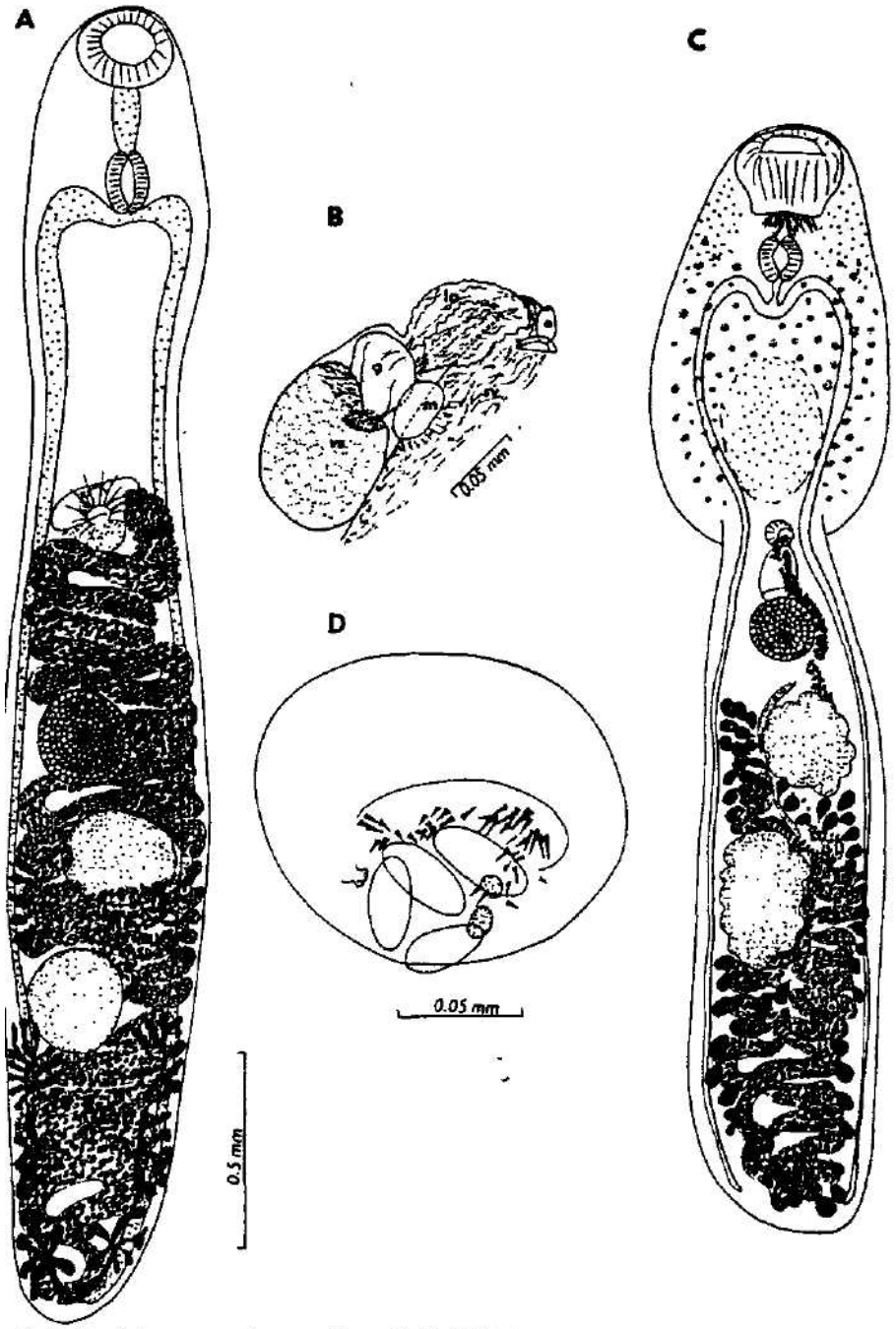
In former Czechoslovakia, *A. muehlingi* adults were recorded from *Larus ridibundus* and *Sterna hirundo* from South Bohemia, Moravia and Slovakia (Vojtek, 1959; Vojtek & Vojtková 1961; Zajiček & Páv, 1961; Páv & Zajíček, 1963; Macko, 1964; Sitko, 1968; Bušta et al., 1985; Bušta & Groschaft, 1986); metacercariae of this parasite were found in 14 species of cyprinid fish in South Moravia and Slovakia (Vojtek, 1981). The present finding is the first report of *A. muehlingi* from cormorants in the region of former Czechoslovakia.

The species was found to be an infrequent parasite of cormorants in South Moravia.

7. *Galactosomum lacteum* (Jagerskiöld, 1986) Fig. 2 A, B

Syn.: *Monostomum lacteum* Jagerskiöld, 1896.

DESCRIPTION (2 specimens): Body elongate, slender, 2.72-3.07 long and 0.33-0.40 wide, divided into somewhat narrower forebody and wider hindbody. Constriction between fore- and hindbody slightly pronounced, lying in front of ventrogenital sac. Oral sucker subterminal, 175-214 x 158-175 in size. Prepharynx present, longer than pharynx; size of pharynx 100 x 75. Gut bifurcating nearly immediately behind pharynx so that oesophagus almost absent. Behind bifurcation, caeca first directed anteriorly and then bent backwards, thus forming distinct arch; posteriorly, caeca reaching near to posterior extremity. Ventrogenital sac relatively small, median, situated




ţ. 2. A, B - *Galactosomum lacteum* (Jagerskiöld, 1896) (A - general view, B - ventrogenital complex: e - · gonotyl, lp - lateral pocket, m - mouth of ventrogenital sac, vs - ventral sucker, sv - seminal vesicle); C,D *trioides aharonii* Witenberg, 1929 (C - general view, D - ventrogenital complex).

near border of first and second thirds of body. Ventral sucker small, asymmetric, unsucker-like, measuring 77-103 x 54-75; provided with anterior lobes armed with uninterrupted field of small spines up to 5 long. Lateral pocket present, rather large. Gonotyl relatively large, unarmed. Seminal vesicle large, overlapped by eggs. Ejaculatory duct relatively short and narrow. Testes oval, almost tandem (slightly oblique); size of anterior testis 252 x 234; that of posterior testis 284 x 284. Ovary nearly equatorial, submedian, measuring 245 x 265. Vitellaria forming several (about 8) rosettes; most of them situated behind posterior testis. Uterus strongly coiled, forming numerous loops and filling two posterior thirds of body. Eggs measuring 22-24 x 11.5-13.

Site: anterior and middle part of small intestine.

Locality: South Moravia: Nové Mlýny water reservoir near the village of Dolní Věstonice - April 1992.

COMMENTS: The specimens from the common cormorant were partly destroyed, probably due to their quick decomposition in the host's intestine after the death of the bird. Consequently, only two specimens were measurable and some morphological characteristics were hardly observable. However, the gross morphology and particularly the structure of the ventrogenital complex clearly suggest that the specimens belong to the genus *Galactosomum* Looss, 1899, and fall in the group comprising *G. lacteum* (Jagerskiöld, 1896) and *G. phalacrocoracis* Yamaguti, 1939 as defined by Pearson (1973).

The classification of the *Galactosomum* species had been based mainly on the body shape, the position of caecal bifurcation and genital organs (testes, ventrogenital complex, vitellaria), the presence of oesophagus, etc. (see Morozov, 1952) until Pearson (1973) published a comprehensive revision of this genus. This author based his classification particularly on the structure of the ventrogenital complex, the study of which had previously been overlooked.

According to Pearson (1973), members of *G. lacteum* group are characterized mainly by the ventrogenital sac opening well behind the intestinal bifurcation and ventral sucker being asymmetric, highly modified (insucker-like) with a spined knob (lobe) and an eversible spiny cavity. Other features, typifying members of this group, i.e. two-chambered seminal vesicle and a long excretory vesicle, could not be observed, because the proximal part of the seminal vesicle as well as the excretory vesicle were completely overlapped by numerous eggs.

The specimens under study can be distinguished from *G. phalacrocoracis* as described by Yamaguti (1939) and Pearson (1973), on the basis of the following morphological characteristics (see Pearson et al., 1978): (i) there are no prominent radial fibres arising from the wall of the ventrogenital sac; (ii) there is no bundle of muscle fibres running from the gonotyl to the posterior lip of the mouth of the ventrogenital sac; (iii) spines on the ventral sucker are not distinctly separated into two groups; (iv) vitelline follicles do not extend anterior to ovary. Consequently, the specimens found in the common cormorant from South Moravia are designated as *G. lacteum*.

Adults of *G. lacteum* have been reported from *Phalacrocorax carbo* in Norway and Wales, from *P. carbo maroccanus* in Morocco, *P. aristotelis* in Crimea, *Ardea cinerea* in Great Britain, *Sterna hirundo* and *Hydroprogne tschegrava* in the Black Sea; metacercariae are found encysted in marine fish (*Cottus scorpius, C. bubalis, Smaris chriselis, Anos tricirrhata, Blennius sp., Gadus merlangus, Acipenser sturio, Bothus maeoticus, Trachinus draco, Trachurus trachurus, Uranoscopus scaber, Scorpaena porcus*) in Sweden, Scotland and the Black Sea in the then USSR. The present finding represents the first record of *G. lacteum* in Central Europe.

Ten *G. lacteum* specimens were found in the only one cormorant.

8. *Cercarioides aharonii* Witenberg, 1929 Fig. 2 C, D

Syn · *Cercarioides baylisi* Gohar, 1930; *C. gonacathodes* Deblock, 1966, *C. orientalis* Gu, Qui, Li et Zhu, 1979.

DESCRIPTION (1 specimen): Body 5240 long, divided into pyriform forebody, measuring 1920 x

1210, and elonguste hindbody, 3320 x 930 in size; ratio forebody: hindbody 0.58 : 1. Oral sucker subterminal, 410 long and 536 wide. Prepharynx and oesophagus shorter than pharynx; size of pharynx 202 x 164. Caeca arched behind bifurcation, reaching posteriorly near body extremity. Ventrogenital complex small, median, near junction of fore- and hindbody. Ventral sucker circular, measuring 196 x 145, its cavity armed posteriorly with three sclerotized knobs and large spines in linate group laterally and anteriorly. Testes slightly lobed, diagonal, measuring 485 x 441 (anterior) and 554 x 441 (posterior). Seminal vesicle thin-walled, bipartite, with smaller proximal and much larger distal parts. Ovary rounded, pretesticular; diameter of ovary 296 x 296. Vitelline follicles extending from anterior margin of anterior testis to posterior extremity, localized intracaecally. Uterus tubular, filling large space of posterior part of hindbody. Eggs oval, measuring 47-51 x 22-24 (average 49 x 23).

Site: cloaca.

Locality: South Moravia: Nové Mlýny water reservoir near the village of Dolní Věstonice - April 1992.

COMMENTS: The specimen from *P. carbo* well corresponds in its morphology to that of *C. aharonii* specimens redescribed by Pearson & Prévot (1985). Their mutual comparison indicates that the specimen studied is considerably larger than Witenberg's specimen (holotype) of *C. aharonii* from *Puffinus kuhli kuhli* in Israel as well as comparative material from *Butorides striatus* in Malaysia; however, it is smaller than specimens found in gulls (*Larus argentatus* and *L. novaehollandiae*) from Far East and Australia, respectively (Pearson & Prévot, 1985).

In then Czechoslovakia, *C. aharonii* was reported by Sitko (1968) from *Sterna hirundo* in Nová Ves near Pohořelice, South Moravia (under the name *C. ahoaroni* (sic!)) and from *Larus ridibundus* and *Sterna hirundo* in Klec near Lomnice nad Lužicí, South Bohemia by Bušta et al. (1985) and Bušta & Groschaft (1986). South Moravian locality is very close to the Nové Mlýny water reservoir, where the specimen studied was found. Both the specimens are morphologically rather similar, differing only in size of eggs: 47-51 x 22-24 m in the specimen of the present material while only 38.2 x 21.5 m in Sitko's specimen. However, the eggs of *C. aharonii* are considerably variable in their size and, according to Pearson & Prévot (1985), their length ranges from 36 to 55 m and width from 18 to 32 μm.

The species *C. aharonii* has hitherto been found in *Puffinus kuhli kuhli* (type host), *Sterna hirundo, S. sandvicensis, Hydroprogne tschegrave (= H. caspia), Larus argentatus, L.crassirostris, L. genei, L. ichthyaetus, L.minutus, L. novaehollandiae L. ridibundus, L.schistisagus, Butorides striatus, Egretta dimorpha, Anser anser domesticus* and *Sturnus vulgaris* from Israel (type locality), Mozambique, Poland, Czechoslovakia, then USSR (Black Sea, Dniepr and Amur Rivers), China, Southeast Asia, and Australia (Pearson & Prévot, 1985). Consequently, the common cormorant, *Phalacrocorax carbo*, represents a new host of this parasite.

A single specimen of this species was found in one cormorant.

9. *Phagicola (Metascocotale) longus* (Ransom, 1920) Fig. 3A

DESCRIPTION (3 specimens): Body elongate pyriform, 690-800 (757) long and 270-290 (277) wide, provided with prominent preoral lobe. Body surface covered with tegumental spines larger anteriorly. Oral sucker slightly subterminal, measuring 65-80 (72) x 48-57 (53), provided with conical, posteriorly directed appendix (cone), 65-80 (75) long. Sucker surrounded by single row of 16 circumoral spines, 15-19 (18) long. Prepharynx much longer than oesophagus; pharynx oval, measuring 40-52 (46) x 38-42 (40). Caeca reaching anterior margin of testes. Ventral sucker small (diameter 45-47 (46) x 45-48 (47)), included in genital atrium, possessing in its anterior part double gonotyl. Genital pore radially surrounded by columns of vesicular tissue. Testes transversaly oval, symmetrical, lying near posterior extremity. Left testis 35-55 (47) long and 55-60 (57) wide; right testis 27-45 (39) long, 55-75 (63) wide. Seminal vesicle slightly preovarial, divided into two parts. Ovary, lying anterior to right testis, 48-75 (59 x 65-75 (71) in size.

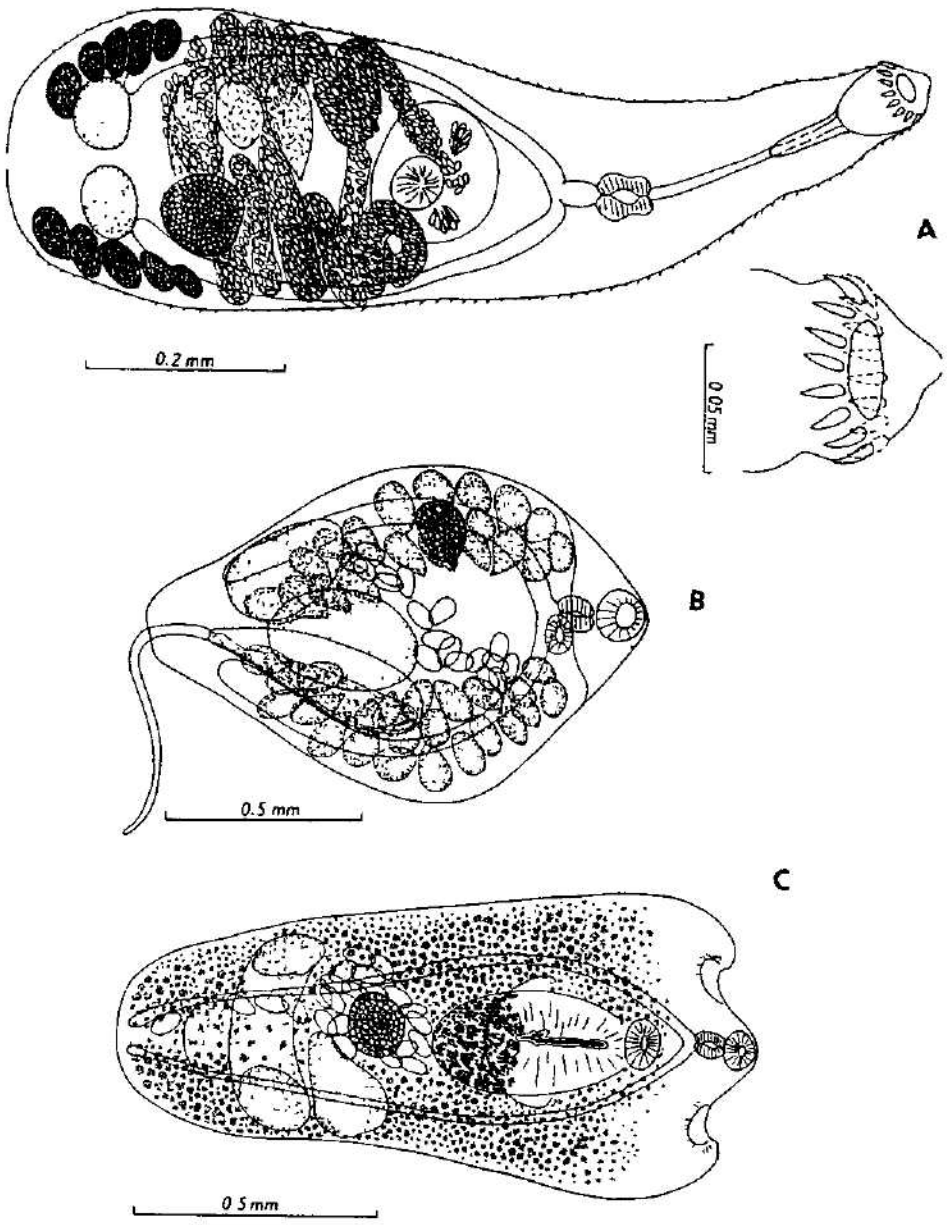



Fig. 3. A - *Phagicola* (*Metascocotyle*) *longus* (Ransom, 1920); B - *Holostephanus dubinini* Vojtek et Vojtková, 1968; C - *Hysteromorpha triloba* (Rudolphi, 1819).

Seminal receptacle large, median and oblique to ovary. Vitelline glands consisting of about 5 follicles on each side. Uterus tubular, forming several loops filling hindbody. Eggs oval, measuring 17-18.5 (17.6) x 9-12 (10.7).

Site: anterior part of small intestine.

Locality: South Moravia: Nové Mlýny water reservoir near the village of Dolní Věstonice - April 1992.

COMMENTS: The trematodes under study, characterized mainly by the presence of a conical appendix at the oral sucker and a single row of circumoral spines, clearly belong to the genus *Phagicola* Faust, 1920 (subgenus *Metascocotyle* Ciurea, 1933 sensu Yamaguti, 1971). Other morphological features such as long caeca reaching to the level of testes, vitelline glands composed of low number (only 5 on each side) of well separated follocles, and circumoral spines measuring 15-19 m in length, indicated the appurtenance of these trematodes to the species *P. longus* as described and illustrated by Morozov (1952), Hutton & Sogandares-Bernal (1958), Reimer (1969) and Rietsche & Werding (1978). This widely distributed species has been found in carnivores (domestic cat, dog, *Canis lupus, Vulpes lagopus, Lutra*) ands birds (*Milvus migrans, Pelecanus occidentalis californicus, Casmerodius albus egretta, Sula leucogaster, Leucophoyx thula*) from America (Alaska, Panama, Columbia), Israel, Greece, Roumania and Georgia; Reimer (1969) reported the occurrence of this trematode in the common cormoramt, *Phalacrocorax carbo sinensis*, from nothern coast of the former East Germany. Metaceracariae of *P. longus* have been reported from the heart, conus arteriosus, pericardium, rarely from muscles of fish of the genera *Mugil (M. cephalus, M. curema, M. trichodon), Lichia* and *Barbus* (Morozov, 1952; Yamaguti, 1971, 1975; Rietschel & Werding, 1978).

The present finding is the first report of *P. longus* from Central Europe.

Family Cyathocotylidae Poche, 1925

10. *Holostephanus dubinini* Vojtek et Vojtková, 1968, Fig. 3 B

DESCRIPTION (10 specimens): Body pear-shaped, 976-1472 (1253) long and 672-1152 wide, with maximum width at its anterior third. Anterior third of body covered with fine spines. Body surface with ventral pouch containing enclosed holdfast with central cavity, about 40-50 (47) in diameter. Small, round oral sucker subterminal, 107-155 x 130-183 (132 x 151) in size. Prepharynx absent. Oval muscular pharynx well developed, measuring 78-113 x 75-107 (90x89). Oesophagus absent. Intestinal caeca extending posteriorly to level of posterior end of vitellaria. Acetabulum smaller than oral sucker, size 63-83 x 73-107 (72 x89), situated near intestinal bifurcation. Testes large, irregularly oval, diagonal in position; anterior (left) testis measuring 302-432 x 158-283 (390 x 230), posterior (right) testis 315-480 x 189-304 (373 x 238). Ovary oval, size 138-220 x 100-240 (168 x 154), situated anteriorly to posterior testis. Cirrus sac approximately at same level as anterior testis, usually overlapping latter partly in ventral view; cirrus sac 504-790 (623) long and 126-189 (152) wide. Cirrus thin and long. Vitelline follicles extending from level of intestinal bifurcation to posterior margin of testes. Only small number of eggs present in uterus. Eggs oval, size 95-105 x 65-83 (101 x 75).

Site: intestine (small intestine, less often large intestine).

Localities: South Moravia: ponds near Pohořelice - July 1991, Nové Mlýny water reservoir near the village of Dolní Věstonice - April 1992.

COMMENTS: By their morphology and measurments the present trematodes seem to be practically identical with those described by Vojtek & Vojtková (1968) as *Holostephanus dubinini* from experimentally and naturally infected cormorants from the Volga R. delta in Astrakhan, Russia. Since also the host species (*Phalacrocorax carbo*) is identical, we consider our specimens to belong to this species.

*Holostephanus dubinini* has so far been recorded only from the Volga R. delta in Russia.

According to Vojtek & Vojtková (1968), all the trematodes designated by various authors (e g , Nikolskaya, 1939; Dubinin & Dubinina, 1940) as *Cyathocotyle prussica* Muhling, 1896 and parasitizing cormorants in the Volga R delta were undoubtedly conspecific with *H dubinini*; however, this does not concern *C prussica* from other bird hosts of this region The present finding represents the first record of *H dubinini* from Czech countries as well as from Central Europe In her diploma work, Musilová (1991) has reported a specimen of *Cyathocotyle* sp from a cormorant (*P carbo*) collected in South Moravia, which undoubtedly belongs to *H dubinini* too While *H dubinini* has not hitherto been recorded from cormorants in South Bohemia, it was rather frequent in those coming from South Moravian localities (e g , in the Nové Mlyny reservoir, the prevalence in adult cormorants 44 %, intensity 1-30 (mean 7) trematodes per bird)

According to Vojtek & Vojtková (1968), the first intermediate host of *H dubinini* is the prosobranchiate snail *Bithynia tentaculata* while various cyprinid fishes (*Rutilus rutilus, Abramis brama, Leucaspius delineatus, Gobio gobio, Tinca tinca* and others) serve as its second intermediate hosts, the encysted metacercariae of *H dubinini* are found in gills and muscles

Family Diplostomatidae Poirier, 1886

11. *Hysteromorpha triloba* (Rudolphi, 1819) Fig 3 C

Syn *Holostomum musculicola* Waldenburg, 1860, *Diplostomulum corti* Hughes, 1929, *Cercaria micradena* Cort et Brackett, 1938, *Diplostomum granulosum* Goss 1941, *Parastrigea slovacica* Ryšavy, 1958

DESCRIPTION (10 specimens): Body pyriform or subtriangular, indistinctly two-segmented, with greatest diameter near anterior extremity Length of body 1184-1568 (1341), maximum width 608-752 (695) Posterior end blunt Anterior extremity trilobate, lateral lobes separated from median lobe by depressions corresponding to openings of pseudosuckers Oral sucker small, subterminal, size 70-95 x 73-108 (79 x 96) Prepharynx absent Oval muscular pharynx measuring 60-75 x 48-63 (67 x 55) Oesophagus practically absent Narrow intestinal caeca extending posteriorly to posterior end of body Acetabulum somewhat larger than oral sucker, measuring 75-125 x 105-143 (92 x 128), situated slightly below intestinal bifurcation Holdfast large, circular to transversely elongate, with central cavity opening outside as median slit, its size 347-598 x 271-391 (454 x 309) Anterior testis lateral, asymmetrical, measuring 120-210 x 158-390 (168 x 247). Posterior testis occupying entire breadth of hindbody, concave ventrally, its size 113-158 x 378-504 (139 x 460) Ovary sherical to oval, median or submedian, opposite to anterior testis, size 113-151 x 114-132 (126 x 180) Vitellaria reaching forward beyond acetabulum. Uterus extending posteriorly to region of ovary; it contains at most some twenty oval eggs measuring 95-101 x 65-75 (98 x 70) Small genital bursa situated near posterior end of body

Site small intestine

Localities South Bohemia pond Staré jezero near Chlum u Třeboně - November 1987, pond Ženich near Stara Hlina - August 1989, September 1990, May 1991, South Moravia pond Stary near Pohořelice September 1989 , pond Prostřední near Lednice September 1989, ponds near Pohořelice July 1991, ponds near Jaroslavice July 1991, Nove Mlyny water reservoir near the village of Dolní Věstonice - April 1992, May 1992

COMMENTS The morphology and measurments of specimens of the present material correspond, more or less, to the descriptions of *Hysteromorpha triloba* given by Ciurea (1930) and Dubois (1970)

This species was originally described by Rudolphi (1819) from *Phalacrocorax carbo* in Europe At present it is known to occur in various birds of the orders Pelecaniformes, less frequently of Ciconiiformes, Charadriiformes and Colymbiformes, in Europe, Asia, North and South Americas and Australia According to Sudarikov (1960), *H triloba* appears to be an obligate parasite of cormorants and, therefore, its frequent records from birds belonging to other orders make doubts The following species and subspecies of cormorants are known to harbour

this parasite: *Phalacrocorax carbo* (type host), *P auritus, P carbo hanedae, P. c novaehollandiae, P fuscescens, P melanoleucus, P olivaceus, P. o mexicanus, P. pygmaeus,* and *P sulcirostris* (see Sudarikov, 1960)

In Europe, *Hysteromorpha triloba* has been recorded mainly from *Phalacrocorax carbo* (Austria, Switzerland, Roumania, Serbia, Czechoslovakia, Russia), but also from *P pygmaeus* (Roumania) (e g , Ciurea, 1930; Ryšavý, 1958, Sudarikov, 1960, Bykhovskaya-Pavlovskaya, 1962; Kiškaroly & Tafro, 1988; Moravec et al , 1988) It seems to be a very frequent parasite of cormorants for example in the large river deltas (e g , Danube, Dnieper, Volga) According to Nikolskaya (1939), the prevalence of *H triloba* in adult cormorants from the Volga R delta was 51 %; the mean intensity of *H triloba* infection in cormorants of the same area was 18-19 (maximum 79) trematodes per bird (Dubinin & Dubinina, 1940) The present data show that also in Czechoslovakia *H triloba* is one of the most common helminth parasites of cormorants; for example, in the Nove Mlyny reservoir in South Moravia, 60 % of adult cormorants were infected with the intensity being +-62 (mean 21) trematodes per bird; *H triloba* was frequently recorded also from other localities from where only a small number of adult cormorants were examined

In former Czechoslovakia, adults of this trematode species were first recorded from *Phalacrocorax carbo* from the then nesting colony of cormorants near the village of Podunajske Biskupice in southern Slovakia by Ryšavy (1958) who had considered them to represent a new species, *Parastrigea slovacica*; this was later synonymized, in our opinion quite correctly, with *H triloba* by Dubois (1961) From Czech countries it was reported from *P carbo* from South Bohemia by Moravec et al (1968) and Musilová (1991)

The first intermediate host of *H triloba* are known to be aquatic snails of the genus *Gyraulus* (Sonin, 1986), while the second intermediate hosts are fishes of different families, mainly cyprinids, occasionally also frog and toad tadpoles The encysted metacercariae of *H triloba* are found largely in dorsal and abdominal muscles, less often under the skin In then Czechoslovakia, *H triloba* metacercariae were reported by Vojtek & Vojtková (1971), Pár & Vojtek (1972) and Vojtek (1981) from the cyprinids *Abramis ballerus, A brama, A sapa, Blicca bjoerkna* and *Rutilus rutilus* from south-western Slovakia

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# Revision of the subgenus *Merodiscus* of the genus *Ptomaphagus* (Coleoptera, Leiodidae, Cholevinae)

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**Taxonomy, distribution, Coleoptera, Leiodidae, Cholevinae, *Ptomaphagus, Merodiscus*, lectotype designation**

**Abstract.** The subgenus *Merodiscus* of the genus *Ptomaphagus* is revised. Two species, *P. validus* (Kraatz) and *P. biharicus* Jeannel, are recognized. A key for identification is given, both species are redescribed and illustrated. Differences are found in the shape of the anterior part of spermatheca and of the mesopraesternum, and in proportions of antennal segments. Lectotype is designated for *P. validus*. All available distributional data are presented, the known distributional range of both species is extended.

Subgenus *Merodiscus* was erected by Jeannel (1934) for three species: *Ptomaphagus validus* (Kraatz,1854) and *P. biharicus* Jeannel,1934 from Rumania and Yugoslavia, and *P. forticornis* Matthews,1888 from Mexico. This subgenus was described and distinguished from the remaining two subgenera *Ptomaphagus* s.str. and *Adelops* Tellkampf,1844 in a short key based mainly on antennal structure (l.c., p. 162). The same key was used by Jeannel (1936).

A separate subgenus *Tupania* was later erected by Szymczakowski (1961) for the species *P. forticornis*. In the same paper the restricted status of the subgenus *Merodiscus* was proposed, containing only the species *P. validus* and *P. biharicus*. The key to all four subgenera of *Ptomaphagus* was given (l.c., pp. 147-148), Peck (1973) also adopted this key in his paper.

A series of papers by Peck (1973, 1977, 1984 etc.) concerning the subgenera *Adelops* and *Tupania* showed that characters for recognition of the species of *Ptomaphagus* are mainly on male and/or female genitalia and medial part of mesosternum. Because the distribution of the subgenus *Merodiscus* is wider than given by Jeannel (1936) and Peck (1973), the revision of the available material is presented.

## MATERIAL AND METHODS

Location of old geographic names was found in Andrees Allgemeiner Handatlas, 6. Auflage, Von Velhagen et Klasing Verlag, Bielefeld u. Leipzig 1914, 224 + 532 pp.

Dissections and mountings of the male and/or female genitalia follow the procedure described by Peck (1973).

The material was studied with the aid of a Meopta stereoscopic microscope (magnification up to 100 x) and a Meopta compound microscope (magnification up to 200 x). All measurments were made using an ocular micrometer. A drawing arm was used for all the figures with the exception of male genitalia drawn on Visopan projection microscope (Reichert).

Explanation of abbreviations used throughout the text: CJR - author's collection; CRR - collection R. Rous,

Prague; MHK - Krajské muzeum východních Čech, Hradec Králové; MNHNP - Muséum National d'Histoire Naturelle, Paris; NMP - Národní muzeum, Praha; SNMB - Slovenské národné múzeum, Bratislava; TMB - Természettudományi Múzeum, Budapest; ZIP - Zoological Institute, Russian Academy of Sciences, Petersbourg; ZMB - Zoologisches Museum, Berlin.

## Subgenus *Merodiscus* Jeannel,1934

Jeannel,1934: 162; Jeannel,1936: 69-70; Szymczakowski,1961: 146-148, restricted status; Peck,1973: 57-58

Type species: *Catops validus* Kraatz, 1852 (by original designation)

The members of this subgenus are defined by the antennal segment III 2.0 - 2.5 times longer than segment II.

KEY TO SPECIES

1. Antennal segment III about 2,5 times longer than segment II. Segment IV only slightly wider than long (Fig. 21). Mesopraesternum posteriorly forming right or obtuse angle in lateral view (Figs 15-17). Spermatheca with oblong excavated knob at anterior end (Figs 8,10), forming a sharp angle with shaft when viewed from side (Figs 7,9). Length 5.0 - 6.8 mm. ..... *P. validus*
- Antennal segment III about 2 times longer than segment II. Segment IV distinctly wider than long (Fig. 20). Mesopraesternum posteriorly forming sharp angle in lateral view (Figs 13,14). Spermatheca with round flattened knob at anterior end (Figs, 1,3,5), forming an obtuse angle with shaft when viewed from side (Figs 2,4). Length 3.8 - 4.6 mm ..... *P. biharicus*

SURVEY OF SPECIES

*Ptomaphagus (Merodiscus) validus* (Kraatz,1852) (Figs 7-11,15-19,21-25)

*Catops validus* Kraatz,1852: 441

Redescription:

Body length 5.0 - 6.8 mm. A robust species (Fig. 11). Head, pronotum and elytra reddish brown, antennae and legs reddish, apical half of antennal segment XI yellowish. Dorsal body surface covered with short, very dense, yellow hairs.

Antennae (Fig. 21): segment III about 2.5 times longer than segment II. Segment IV only slightly wider than long, narrower than base of segment VII. Segment VI about 2.5 times wider than long.

Pronotum 1.5-1.7 times wider than head, 1.4-1.5 times wider than long. Elytra 1.3-1.5 times longer than wide. Wings normal. Mesosternal carina low, mesopraesternum posteriorly with right or obtuse angle in lateral view (Figs 15-17).

Spermatheca (Figs 8,10) simple, with oblong, excavated knob at anterior end, forming a sharp angle with shaft when viewed from side (Figs 7,9). Central shaft narrow or slightly curved, posterior end with wide knob.

Stylus (Fig. 19) apically with 2 - 3 long setae, subapically with one smaller seta on each side. Apical two thirds of stylus furnished with small, recurved hooklets (Fig. 19).

Valvifer bearing a dense fringe of about 25-30 setae.

Aedeagus (Fig. 23) in profile straight, relatively robust, gradually tapering, ending with a small downcurved tooth, tip (Fig. 25) broadly rounded dorsally, with a terminal point, from below with a row of 8 small setae on each side. Stylet and internal structure of the aedeagus as on Fig. 22. Each paramere with one small seta apically and two longer ones subapically (Fig. 24). Spiculum gastrale and genital plate normal (Fig. 18).

Variation:

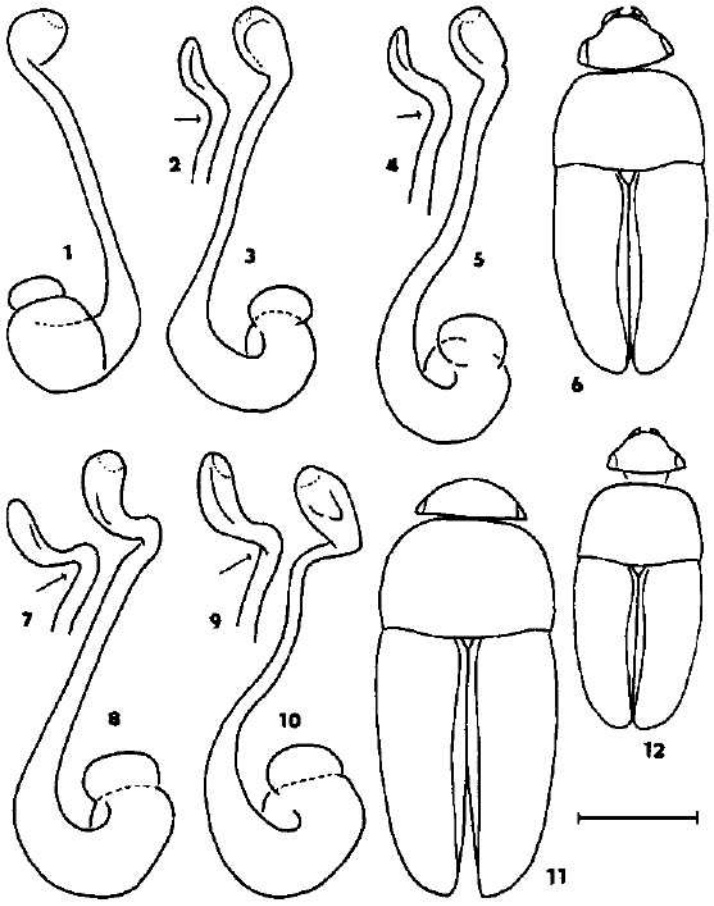
The spermatheca varies slightly in bending of central shaft, in a specimen from Serbia (Fig. 9,10) the central shaft is strongly curved and thinner than in the lectotype, and the angle between

the shaft and the knob on anterior end is less sharp when viewed from side.

Material studied:

Type material: lectotype ♀ (presently designated), labelled: "Hungaria, Stentz [lgt.], Nr. 7443; Type; Umpräpariert xii.34 K.Sokolowski - Hbg.; Zool. Mus. Berlin" (ZMB); paralectotype ♂, labelled: "Hung., Stentz [lgt.], validus Kraatz; 7443; Type; Umpräpariert xii.34 K.Sokolowski - Hbg.; Zool. Mus. Berlin" (ZMB).

Other material: Rumania: "Herkulesf., Mihók, 908 II/25" 1 ♀ (NMP); "Herkulesfürdö, leg.Pável, 1880; 569,607" 1 ♂ (TMB); "Süd Ungarn, Herkulesbad, v.Bodemeyer lgt." 1 ♀ (MHK); "Banat, Herkulesbad, v.Bodemeyer lgt." 1 ♂ (MHK); "Banat Hung., Petra Semenicu, viii.1929; det. Hlisnikovský x.1932" 1 ♀ (NMP); "Bannat, Abeille de Perrin" 1 spec. (MNHNP); "Hungaria merid.; Ptomaphagus validus Kr., coll. Reitter" 1 ♀ (TMB); "Hungaria; coll. Wendler, Mus. Pragense" 1 ♂ (NMP); "Német Bogsán, Merkl (Hung.); coll. Roubal" 1 ♂ (SNMB); Yugoslavia: "Serbien, Merkl; coll. Apfelbeck" 1 ♀ (TMB); "Carniolia, Reitter" 1 ♀ (CRR); "Serbien, Zebe, Grouvelle, coll. Reitter" 1 spec. (MNHNP); Ukraine: Purkary Akkerman. u. Bessarab., Cernavin, 16.iv.911" 1 ♀ (ZIP); dtto, but "10.vi.911; Pt. validus Kr., Jeannel det." 1 ♀ (ZIP).



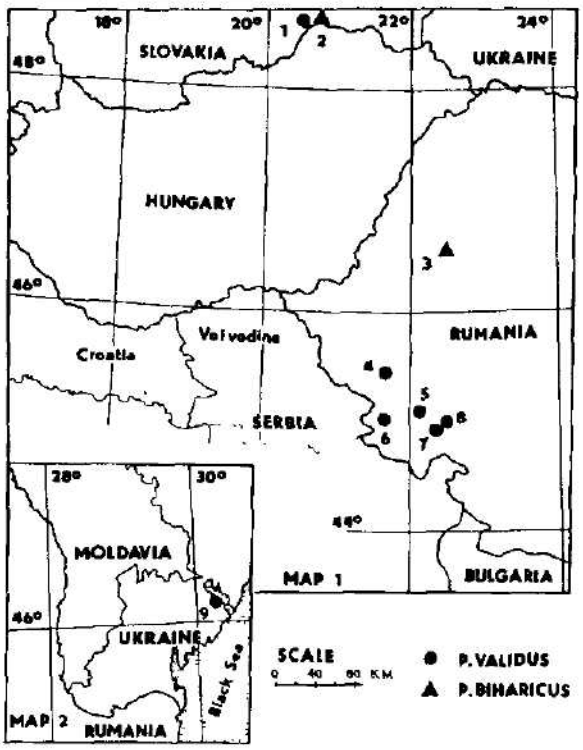

Figs 1-12. 1-3,12 - *Ptomaphagus biharicus* ♀, Dolný vrch; 4-6 - *P. biharicus* ♀, type; 7-8,11 - *P. validus* ♀, lectotype; 9-10 - P. validus ♀, Serbia, Merkl leg.; 1 - spermatheca dorsally; 3,5,8,10 - dtto laterally; 2,4,7,9 - posterior part of spermatheca ventrally; 6,11,12 - habitus dorsally. (Scale 0.15 mm for Figs 1-5, 7-10; 1.5 mm for Figs 6,11,12).

References:

Rumania: Nagy Bogsán, near Resita (Jeannel,1936); Oravicza; Mons **Domoglet; Rumunyest** (all Kuthy,1918); Yugoslavia: Banat Serbe (Jeannel,1936); Slovakia: Slovenský kras, **Slavec - Gombasek** (Gottwald,1982).

Distribution (Maps 1,2):

Rumania: southwestern part (formely a part of Hungary, therefore older material was labelled and referred to as from "Hungaria"); Yugoslavia: Serbia; Slovakia; Ukraine (first record for this area).




Map 1,2. Distribution of *Ptomaphagus (Merodiscus)* species: 1 - Slov. kras, Slavec - Gombasek; 2 - Slov. kras, Dolný vrch; 3 - Bihor, Mt. Detunata; 4 - Német Bogsán; 5 - Banat, Petra Semenicu; 6 - Oravita; 7 - Herkulesfürdö; 8 - Mons Domoglet; 9 - Ukraine, Akkerman, Purkary.

*Ptomaphagus (Merodiscus) biharicus* Jeannel,1934 (Figs 1-6,12-14,20)

*Ptomaphagus (Merodiscus) biharicus* Jeannel,1934: 163

Redescription:

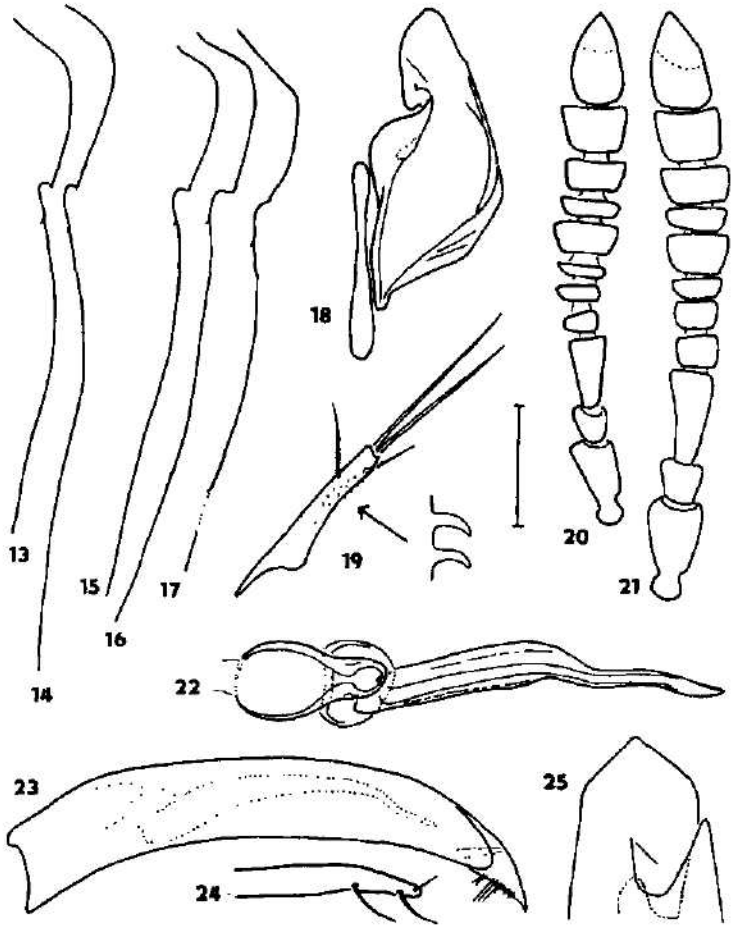
Body length 3.8 and 4.6 mm. A minute species (Figs 6,12). Head, pronotum and elytra reddish brown to dark brown, antennae and legs reddish, apical half of antenal segment XI yellowish. Dorsal surface of body covered with short, dense, yellow hairs.

Antennae (Fig. 20): Segment III about 2.0 times longer than segment II. Segment IV distinctly wider than long, narrower than base of segment VII. Segment VI about 3.5 times wider than long.

Pronotum 1.5 times wider than head, 1.5 times wider than long. Elytra 1.3 and 1.4 times longer than wide. Wings normal. Mesosternal carina low, mesopraesternum posteriorly with sharp angle in lateral view (Figs 13,14).

Spermatheca (Figs 1,3,5) simple, with round flattened knob at anterior end, forming an obtuse angle with shaft when viewed from side (Figs 2,4). Central shaft slightly curved, posterior end with wide knob.

Stylus apically with 2 long setae, subapically with one smaller seta on each side. Apical half of stylus furnished with small, recurved hooklets.




Figs 13-25. 13 - *Ptomaphagus biharicus* ♀, Dolný vrch; 14,20 - *P. biharicus* ♀, type; 15 - P. validus ♀, Serbia, Merkl leg.; 16 - P. validus ♀, Banat, Petra Semenicu; 17 - P. validus ♀, Herkulesfürdö, Mihók leg.; 18,22-25 - *P. validus* ♂, "Hungaria", coll. Wendler; 19,21 - P. validus ♀, lectotype; 13-17 - medial part of mesosternum laterally; 18 - genital segment dorsally; 19 - stylus laterally, detail: hooklets on distal part; 20-21 - right antenna dorsally; 22 - stylet and internal structure of aedeagus dorsally; 23 - aedeagus laterally; 24 - distal part of right paramera laterally; 25 - tip of aedeagus dorsally. (Scale 0.15 mm for Figs 13,14,19,22,24,25; 0.25 mm for Figs 15-18, 23; 0.4 mm for Figs 20,21).

Valvifer bearing a dense fringe of about 25 setae.
Male unknown.

Material studied:

Type material: holotype ♀ labelled: "Detunata, Buscum, R. Jeannel, Trans. vi.25; Type; Muséum Paris, Coll. R. Jeannel, 1931" (MNHNP)

Other material: "Slovakia mer. centr., Slovenský kras, Dolný vrch, 48.46°N 20.69°E, 28.v.1986, R. Mlejnek lgt., mixed forest, under big stone in the sinkhole" 1 ♀ (CJR).

Distribution (Map 1):

Rumania: Bihor; Slovakia (first record for this region and central Europe).

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# Photoperiodic response of *Chironomus plumosus* (Diptera: Chironomidae) under laboratory conditions

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**Photoperiodic response, dormancy, emergency, Diptera, *Chironomus*, larvae**

**Abstract.** The photoperiodic response of *Chironomus plumosus* from the carp ponds in Southwestern Bohemia was investigated. The larvae in the fourth instar are sensitive to photoperiodic signal. Long days and higher temperatures lead to the emergence of most imagines early after the start of the experiments, i.e., after 7-8 weeks, while short days and lower temperatures increased the duration of dormancy to 4-6 months.

## INTRODUCTION

The insects photoperiodism has been intensively studied. Beck (1972) and Saunders (1984) have summarized some aspects of the physiology and ecology of photoperiodism. The photoperiodic response of *Chironomus plumosus* was then investigated experimentally, mainly by Fischer (1974) and Ineichen et al. (1979). The retardation in development occurs in response to the phoroperiod.

Based on this investigation, the course of the development of *Chironomus plumosus* is analyzed here under various light and temperature conditions.

## MATERIAL AND METHODS

The experiments were carried out with the *Chironomus* larvae in the fourth instar originating from the carp ponds in Southwestern Bohemia (1986 - Vitanovské Jezárko, 1987 - Velký Pálenec). The larvae were transferred (24th November 1986, 22th November 1987) to aerated aquaria with a 10-15 mm layer of pond sediment. Yeast in suspension was added. The larvae were exposed to photoperiods of 15L:9D (long day - LD), 12L:12D, 9L:15D (shorter days - SD) at 15± 1°C in the first experiment. In the second experiment two photoperiods (16 h and 8 h, i.e., long and short days) were accompanied by lower and high temperatures (16±1°C and 21±1°C). Installed neon tubes (975 lumens) were controlled by time switches. About 300 individuals were present in an area of 600 $cm^2$ in each series of experiments.

## RESULTS AND DISCUSSION

Fig. 1 depicts the emergence of *Chironomus plumosus* under different photoperiods (15, 12, 9 h) at 15°C. The first imagines appeared around the 19th day and the emergence occurs over a period of about 50 days under LD and about 4 months under SD conditions. 21-25% larvae died under different light conditions at 15°C. The majority of adults was synchronized early after the beginning of emergence mainly under LD conditions, when 103 imagines i.e. about 50% of the

population appeared between the 4 and 12th days. With photoperiod of 12 h, only 58 imagines (i.e., about 30%) emerged after 40-48 days. With photoperiod of 9 h, two peaks of imagines appeared and 30-40 imagines (about 20%) emerged after 4-12 and 40-48 days.

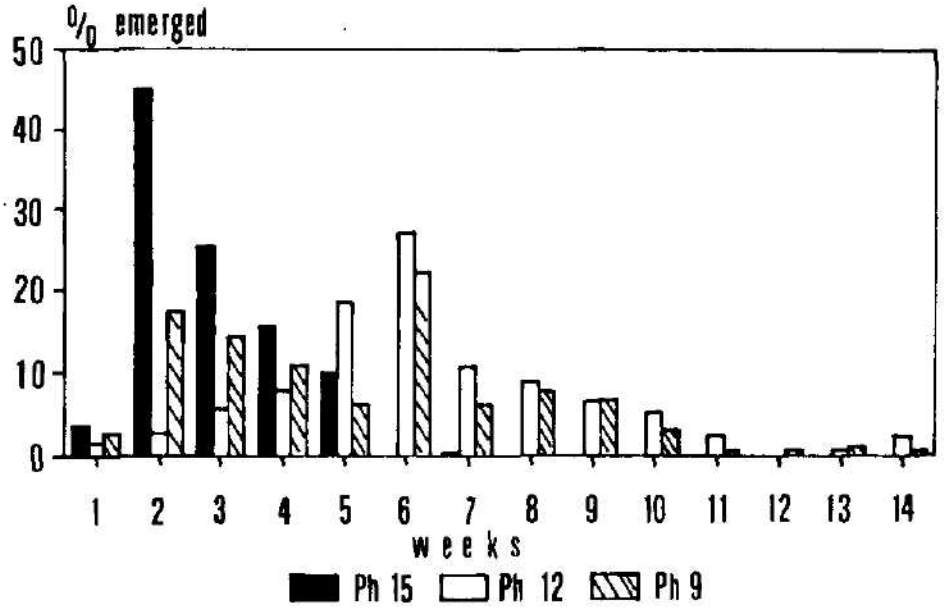


Fig. 1. Emergence of *Chironomus plumosus* under LD and conditions at 15°C.

A dormancy is well known in different groups of insects and various species of the Chironomidae family. In Chironomidae the dormancy occurs at the end of the fourth larval instar in response to the photoperiod. The retardation in development was first found is some chironomids living on water plants (Thienemann, 1921). The phenomenon was observed later in a laboratory population of *Chironomus tentans* (Clever, 1962, Pelling, 1964) and was experimentally demonstrated by Engelmann and Shappirio (1965). The photoperiodic response of three species of Chironomidae was studied by Danks (1978). The influence of the photoperiod on the development of *Chironomus plumosus* was analyzed in detail mainly by Fischer (1974) and Ineichen et al. (1979). A dormancy, induced by short days, has been observed (oligopause). The dormant larvae move, take in food and can also become larger than those which metamorphose directly (Fischer, 1974, Bertogg and Fischer, 1978). The dormancy lasts from a few days to several months, then termination takes place spontaneously (Fischer, 1974, Ineichen et al., 1979).

The development is fundamentally dependent on the temperature, thermic quiescence and strengthening of the photoperiodic oligopause occur at lower temperatures (Fischer, 1974). Therefore, development of the animals was compared under SD and LD conditions at lower and higher temperatures. The course of emergence is shown in Fig. 2. The first imagines appeared around the 10th day and the eclosion time covers a range of about 60 days (larval mortality was 11-13%). The development lasts about 6 months under short day conditions accompanied by lower temperatures (25% of the larvae died). Higher temperature and LD conditions lead to the faster development of most of the individuals. The photoperiodic response is stronger at lower

temperature. Higher temperature leads to synchronic emergence of imagines under SD and LD conditions (about 150 organisms, i.e., 60% of the population appeared around the 4-11th days). Almost the same situation was recorded for long day accompanied by lower temperature (111 imagines, i.e., 45% emerged in the same time). The animals tend toward dormancy not only under SD conditions but also with long days (Fischer, 1974, Ineichen et al., 1979) and at high temperature (Matěna, 1984). It was observed, in contrast to the other authors, that the organisms survive well under unnatural conditions, when SD and high temperature were combined.

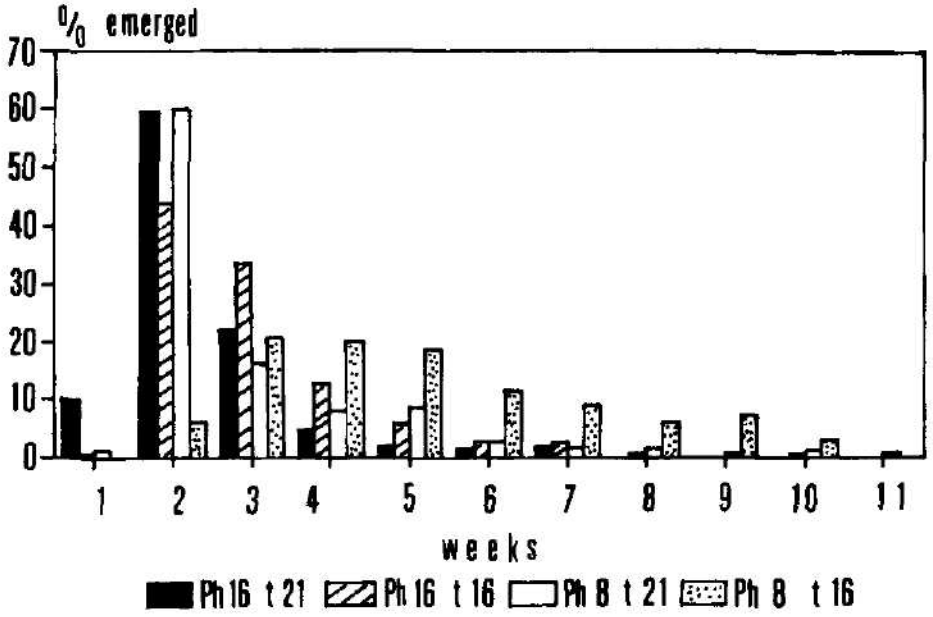


Fig. 2. Emergence of *Chironomus plumosus* under LD and SD conditions at 16 and 21°C.

A much more complicated situation can be observed under natural conditions where the changes of temperature and photoperiod are repeated and many interactions affect the larvae. Nonetheless, some general conclusions could be drawn. It is evident that the photoperiod and dormancy appear to play an important role in the ecology of *Chironomus plumosus* under natural conditions. As the days become shorter in late summer, the larvae enter dormancy and are ready for winter. The long day dormancy is important during periods of bad weather in the summer (Fischer, 1974). The population that has survived the winter does not emerge synchronously (differing tendency to dormancy) and emergence is influenced mainly by the temperature (Ineichen et al., 1979). Fischer (1974) distinguishes two ecological races of *Chironomus plumosus* on the basis of different tendencies to dormancy - "river plumosus" (dormancy is induced by short days at low temperatures) and "lake plumosus" (dormancy occurs in response to a short photoperiod at all temperatures).

## CONCLUSION

1. The photoperiodic response of *Chironomus plumosus* from carp ponds was investigated after transfer to several laboratory combinations of photoperiod and temperature. The results reflect the sensitivity of the individuals in the fourth larval instar to the photoperiodic signal.

2. The dormancy occurred mainly under short-day conditions at lower temperatures. This state lasted for 4-6 months in some organisms. At high temperatures, the imagines emerged independently of the day-lenght and the development of the larvae lasted about 7-8 weeks. Almost the same situation was observed under long-day conditions accompanied by lower temperatures.

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# New and Interesting Oribatid Species of the Family Euphtiracaridae (Acari: Oribatida) from Cuba.

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**Taxonomy, description, *Microtritia, Pocsia*, Euphthiracaridae, Oribatida, Cuba**

**Abstract.** Two new species of oribatid mites, *Microtritia glabrata* sp.n., and *Pocsia microseta* sp.n. have been described and figured. Eight other Cuban species and subspecies of the family Euphthiracaridae have been listed.

## INTRODUCTION

About 72 species and subspecies of the family Euphthiracaridae have been described so far. They are distributed from tropics to northern and southern forest boundary. They have not been founded in soils of tundra. This group is numerous on species in temperate zone of Palearctic and Nearctic region and in tropical soils, too.

Investigations of the Cuban fauna of oribatid mites have started by the work of Balogh & Mahunka (1974, 1978, 1979, 1980) and followed by other authors (Vasiliu & Calugar, 1977, Calugar & Vasiliu; 1977; Scul & Jeleva, 1984), but record of species of this family have not been published so far, only *Rhysotritia ardua* has been recorded by Scul & Jeleva (1984) from Cuba, but this paper doesn't allow to make a precious comparision. Altogether 10 species of this family have been found in large material of soil mites collected by Dr J. Rusek in Cuba and given kindly to the author for determination. Description of two new species is given in this contribution.

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K-146, Cuba, Province Habana, Catalina de Güines, Cueva El Mundo 13. 11. 1979, guano sample leg. J. Rusek,
K-150, Cuba, Province, Guantanámo, Jamaica, 17. 11. 1979, pasture soil sample, leg. J. Rusek.
K-152, Cuba, Province, Guantanámo, 17. 11. 1979, garden of Instituto del Suelos, soil sample, leg. J. Rusek.
K-153, Cuba, Guantanámo, 17. 11. 1979, garden of Instituto del Suelos, soil sample, leg. J. Rusek.
K-154, Cuba, Guantanámo, 17. 11. 1979, garden of Instituto del Suelos, sample of moder and decaying wood from a tree, leg. J. Rusek.
K-155, Cuba, Guantanámo, 17. 11. 1979, garden of Instituto del Suelos, soil sample bellow *Casuarina* sp., leg. J. Rusek
K-170, Cuba, Habana, Nautico. 27. 11. 1979, garden, sample of decaying wood with termites, leg. J. Rusek.
K-178, Cuba, Province Cienfuegos, Soledad, 30. 11. 1979, botanical garden, old forest, soil sample, leg. J.Rusek.
K-184, Cuba, Province Cienfuegos, Soledad, 30. 11. 1979, botanical garden, old forest, sample of decaying bromelias, leg. J. Rusek.

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K-190, Cuba, Province Cienfuegos, Soledad, 30. 11 1979 botanical garden near a brook, litter and soil sample from bamboo stand, leg. J. Rusek.

K-192, Cuba, Province Sancti Spiritus, Escambray, Topes de Collantes, 1. 12 1979, *Pinus caribea* plantation, litter sample, leg. J. Rusek.

K-194, Cuba, Province Sancti Spiritus, Escambray, Topes de Collantes, 1. 12. 1979, *Pinus caribea* plantation, decaying bark sample , leg. J. Rusek.

K-197, Cuba, Province Sancti Spiritus, Escambray, Topes de Collantes, 1. 12. 1979, *Pinus caribea* plantation, sample of fine roots from tree fern, leg. J. Rusek.

K-198, Cuba, Province Sancti Spiritus, Escambray, Topes de Collantes, 1. 12. 1979, *Pinus caribea* plantation, soil sample, leg. J. Rusek.

K-200, Cuba, Province Sancti Spiritus, Escambray, Topes de Collantes, 1. 12. 1979, moist soil sample from forest near stream, leg. J. Rusek.

K-203, Cuba, Province Sancti Spiritus, Escambray, Topes de Collantes, 1. 12. 1979, soil sample from pasture, leg. J. Rusek.

K-206, Cuba, Province Sancti Spiritus, Escambray, Topes de Collantes, 1. 12. 1979, forest, soil sample leg J. Rusek.

K-207, Cuba, Province Sancti Spiritus, Escambray, Topes de Collantes, 1. 12. 1979, giant fern stand near stream, litter and soil sample, leg. J. Rusek.

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K-216, Cuba, Isla de la Juventud, Nueva Gerona, 28. 11. 1979, soil sample, leg. J Hindák.

K-229, Cuba, Province Pinar del Rio, Sumidero, Pica Pica, 8. 12. 1979, near Cueva del Resogadero, sample of drift wood near stream, leg. J. Rusek.

K-230, Cuba, Province Pinar del Rio, Sumidero, Pica Pica, 8. 12. 1979, near entrance of Cueva Obscura, forest soil sample, leg. J. Rusek.

K-231, Cuba, Province Pinar del Rio, Sumidero, Pica Pica, 8. 12. 1979, forest sample of rooting wood, leg. J. Rusek.

K-236, Cuba, Province Pinar del Rio, Pas de Guajaibón, 7. 12. 1979, rain mountain forest, litter sample, leg. J.Borhidi.

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K-249, Cuba, Province Cienfuegos, Yaguramas, 13. 12. 1979, soil sample, leg P. Šmíd

K-262, Cuba, Province Cienfuegos, Yaguramas, 2. 10. 1981, forest, mull and soil sample, leg. J Rusek.

K-266, Cuba, Province Cienfuegos, Yaguramas, 2. 10. 1981, forest soil, litter sample, leg J. Rusek.

K-267, Cuba, Province Cienfuegos, Yaguramas, 2. 10. 1981, forest mull sample, leg. J. Rusek.

K-268, Cuba, Province Cienfuegos, Yaguramas, 2. 10. 1981, forest deciduous wood sample with termites, leg. J. Rusek.

K-270, Cuba, Province Cienfuegos, Yaguramas, 2. 10. 1981, forest, deciduous wood sample with termites, leg. J. Rusek.

K-271, Cuba, Province Cienfuegos, Yaguramas, 2. 10. 1981, forest, deciduous wood sample, leg. J. Rusek.

K-272, Cuba, Province Cienfuegos, Yaguramasw, 2. 10. 1981., forest decaying wood of palma sample, leg J Rusek.

K-283,Cuba, Moa, 20. 10. 1981, soil sample, moder bellow *Pinus and Cocothrinax* sp., leg. J. Rusek.

K-287, Cuba, Moa, 20. 10. 1981, sample of litter, moder and soil, leg. J. Rusel.

K-293, Cuba, Province Holguin, Guchillas de Moa, east of Punta Gorda, 20. 10 1981, humus sample, submontane forest, leg. J. Rusek.

K-299, Cuba, Province Holguin, Guchillas de Moa, east of Punta Gorda, 20. 10. 1981, submontane forest, bark and mosses sample, leg. J. Rusek.

K-300, Cuba, Santiago, 21. 10. 1981, *Pinus carribea* stand, montane forest, tangel humus and soil sample, leg. J.Rusek.

K-301, Cuba, Santiago, Gran Piedra, 21. 10. 1981, *Pinus caribea* stand, grasses soil sample, montane forest, leg. J. Rusek.

K-303, Cuba, Santiago, Gran Piedra, 21. 10. 1981, montane forest, north slope, *Juniperus* sp. litter and soil sample, leg J.Rusek.

K-305, Cuba, Santiago, Gran Piedra, 21. 10. 1981, *Juniperus* sp. montane forest, sample of *Juniperus* wood, leg. J. Rusek.

K-307, Cuba, Santiago, Gran Piedra, 21. 10. 1981, tree fern stnsad, west slope, soil sample, leg. J. Rusek.

K-308, Cuba, Santiago, Gran Piedra 21. 10 1981, tree fern stand, west slope dark moder sample, leg. J. Rusek.

K-309, Cuba, Santiago, Gran Piedra, 21. 10. 1981, tree fern stand, north slope, moss sample, leg. J. Rusek.

K-314, Cuba, Province Habana, Arroyo Bermejo, 16 11. 1981, semideciduous forest, north slope, litter and the moder sample, leg J. Rusek

K-321, Cuba,Province Habana, Arroyo Bermejo, 16. 11 1981, semideciduous forest, decaying wood from a log, leg. J Rusek

K-322, Cuba, Province Habana, Arroyo Bermejo, 16. 11. 1981, semideciduous forest, north slope, litter sample, leg. J. Rusek.

K-323, Cuba, Province Habana, Arroyo Bermejo, 16. 11. 1981, semideciduous forest, north slope, soil sample, leg. J. Rusek.

K-325, Cuba, Province Habana, Arroyo Bermejo, 16. 11. 1981, *Coccoloba* sp. forest, sea shore, litter sample, leg. J. Rusek.

K-326, Cuba, Province Habana, Arroyo Bermejo, 16. 11. 1981, *Coccoloba*, sp. forest, sea shore, sandy soil sample, leg. J. Rusek.

K-327, Cuba, Province Pinar del Rio, Sierra del Rosario, Yagrumal, 18. 11. 1981, submontane forest, rendzina sample, leg J Rusek.

K-330, Cuba, Province Pinar del Rio, Sierra del Rosario, Yagrumal, 18. 11. 1981, submontane forest, decaying wood from a log, leg. J. Rusek.

K-334, Cuba, Province Pinar del Rio, Sierra del Rosario, vayesito, 18. 11. 1981, submontane forest, mull rendzina sample, leg. J. Rusek.

K-336, Cuba, Province Pinar del Rio, Sierra del Rosario , vayesito, 18. 11. 1981, submontane forest, dry bark from a log, leg. J Rusek.

K-337, Cuba, Province Pinar del Rio, Sierra del Rosario, vayesito, 18. 11. 1981, submontane forest, litter and moder sample, leg. J. Rusek.

K-339, Cuba, Province Pinar del Rio, Sierra del Rosario, vayesito, 18. 11. 1981, submontane forest, litter sample, leg. J. Rusek

K-340, Cuba, Province Pinar del Rio, Sierra del Rosario, vayesito, 18. 11 1981, submontane forest, mull-like moder, leg. J. Rusek.

K-341, Cuba, Province Pinar del Rio, vayesito, 18. 11. 1981, Sierra del Rosario, submontane forest, litter and moder sample, leg J. Rusek.

K-A001, Cuba, Habana, 15. 9. 1969, litter bellow *Pinus* sp., soil and litter sample, leg. E. Gordeeva

## LIST OF IDENTIFIED SPECIES OF ORIBATID MITES

*Microtritia glabrata sp.n.* - K-189 (lex.), K-198(1ex) K-283(13ex.), *K-(293ex).*
*Microtritia incisa* Markell, 1964 - K-237(lex), K-327(lex), K-330(lex.), K-336(4ex.), K-337(2ex).
*Microtritia tropica* Markell, 1964 - K-308(lex.)
*Pocsia microseta* sp.n. - K-322(2ex), K-323(3ex),

*Rhysotritia ardua* (C. L. Koch, 1840) - K-229(lex), K-150(lex)

*Rhysotritia cf. ardua otaheitensis* Hammer, 1971, - K-203(lex), K-216(lex), K-229(2ex), K-300(3ex), K-336(4ex),

*Rhysotritia comtae* Mahunka, 1983 - K-146(lex), K-152(3ex), K-153(3ex.), K-154(lex.), K-155(lex.), K-170(lex.), K-178(2ex.), K-184(2ex.), K-190(lex.), K-197(lex.), K-207(2ex.), K-209,(6ex.), K-216(3ex.), K-236(3ex.), K-237(lex.), K-249(lex.), K-262(4ex.), K-266(5ex.), K-267(17ex.), K-268(2ex.), K-270(19ex.), K-271(3ex.), K-272(lex.), K-293(lex.), K-300(9ex.), K-301(lex.), K-303(5ex.), K-305(lex.),K-307(2ex.), K-321(2ex.), K- 325(lex.), K-326(2ex.), K-336(2ex.), K-339(lex.), K-341(lex.)

*Rhysotritia cf. rasile* Mahunka, 1982 - K-190(5ex.), K-194(2ex.),K-197(2ex.) K-198(2ex.), K-200(2ex.), K-236(lex.), K-240(lex.),K-299(lex.), K-301(lex,), K-303(2ex.), K-308(2ex.), K-309(2ex.).

*Rhysotritia clavata Märkell, 1964 K-155*(2ex.), *K-170*(3ex.) *K-174*(2ex.), *K-206*(lex.), *K-207*(lex.), *K-*

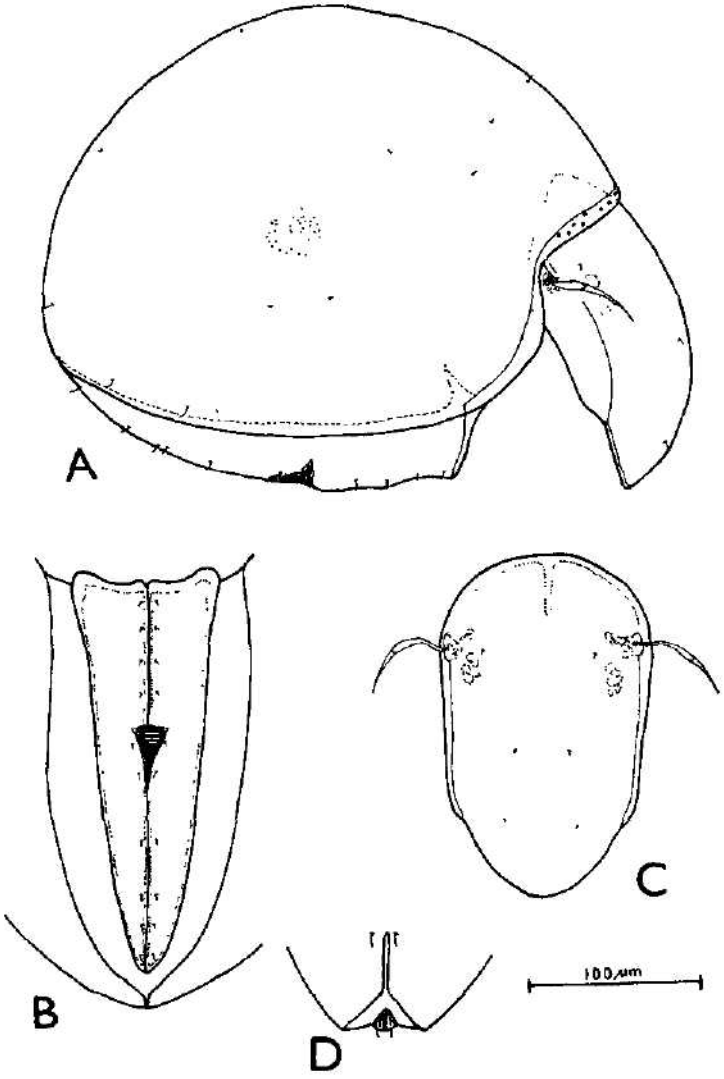


**Fig. 1.** ***Microtritia glabrata*** **sp.n., A - lateral view on the body without legs, B - anogenital region, ventral view, C - aspis in dorsal view, D - posterior part of the body. Scale 100 µm.**

229(3ex.), K-230(lex.) ,K-231(2ex.), K-314(6ex.), K-322(3ex.), K-336(2ex.), K-340(lex.), K-A0001(5ex.).
*Rhysotritia cf. simile* Mhunka, 1982 K-283(5ex.), K-287(lex.),

*Microtritia glabrata* **sp.n.** (Fig.1A-D,2A-B,3A-D)

DIAGNOSIS: clavus of sensillus with very long spike, long terminal fissura, all notogastral and aspal setae very fine.

DESCRIPTION: length of aspis 125-135 µm, breadth of aspis 115-128 µm, length of notogaster 250-285 mum, heith of notogaster 185-205 µm, breadth of notogaster 170-195 µm. Colour light yellow. Cuticle smooth without thick layer of cerotegument and conspicuous structure.

Aspis (fig. 1A,C) with one lateral carina, all aspal setae very fine, badly observable, exobothridial ones not observable. Distance between rostral and lamellar setae approximately equal and distance between interlamellar setae approximately 2x shorter than between interlamellar ones. Base of interlamellar setae in half distance between interlamellar and rostral ones. Comparatively long sensillus extended in half its length. Clavus of sensillus with very long and sharp spike. Bothridial squama situated under comparatively small bothridium. Near bothridium, under lateral carina 4-5 fine sclerotized spoots.

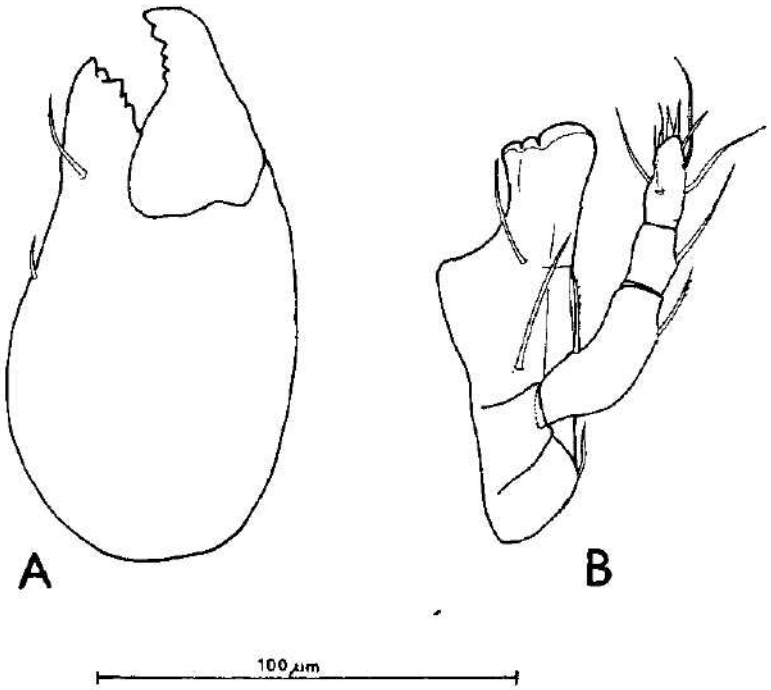


Fig. 2. *Microtritia glabrata* sp.n., A - rigth chelicera in lateral view, B - left palpus with rutelum. Scale 100 µm.

Notogaster (Fig. 1A) almost globular, smooth without distinct structures. All 14 pairs of notogastral setae very fine, badly observable. Fissura terminalis long, reaching to the base of setae ps3. Collar on anterior part of notogaster with some fine foveolae.

Anogenital region (Fig. 1B), anogenital plates smooth with 4 pairs of genital, 3 pairs of anal

and 4 pairs of adanal setae, adgenital ones not observable. Genitoadgenital and adanalanal plates separated by one long and distinct interlocking triangle situated approximately in the half of anogenital region. All setae of this region very fine and smooth, all approximately in the same length.

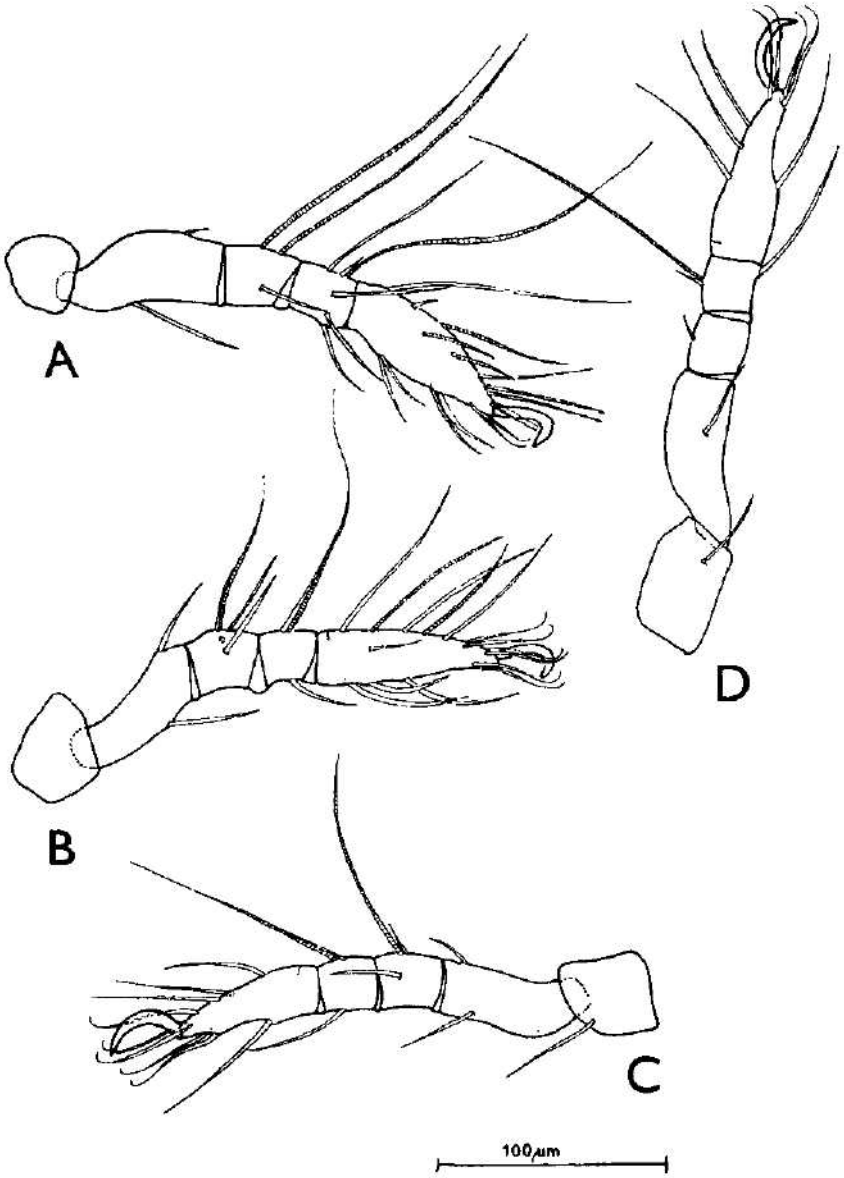


Fig. 3. *Microtritia glabrata* sp.n., A - right leg. I, antiaxial view, B - leg II, antiaxial view, C - leg. III, paraxial view, D - right leg IV, antiaxial view. Scale 100 µm.

Chelicerae (Fig. 2A) robust, without Trägard's organ, measurements of digitus fixus 115x63 um, and digitus mobilis 35x25 um, both with 5 blunt teeth. Seta chb 2x longer than cha, both smooth with sharp spike.

Palps (Fig. 2B) with three joints, chaetotactic formula 2-1-8(1), originated on genae with comparatively large rutellum with 2 distinct incisions on the top.

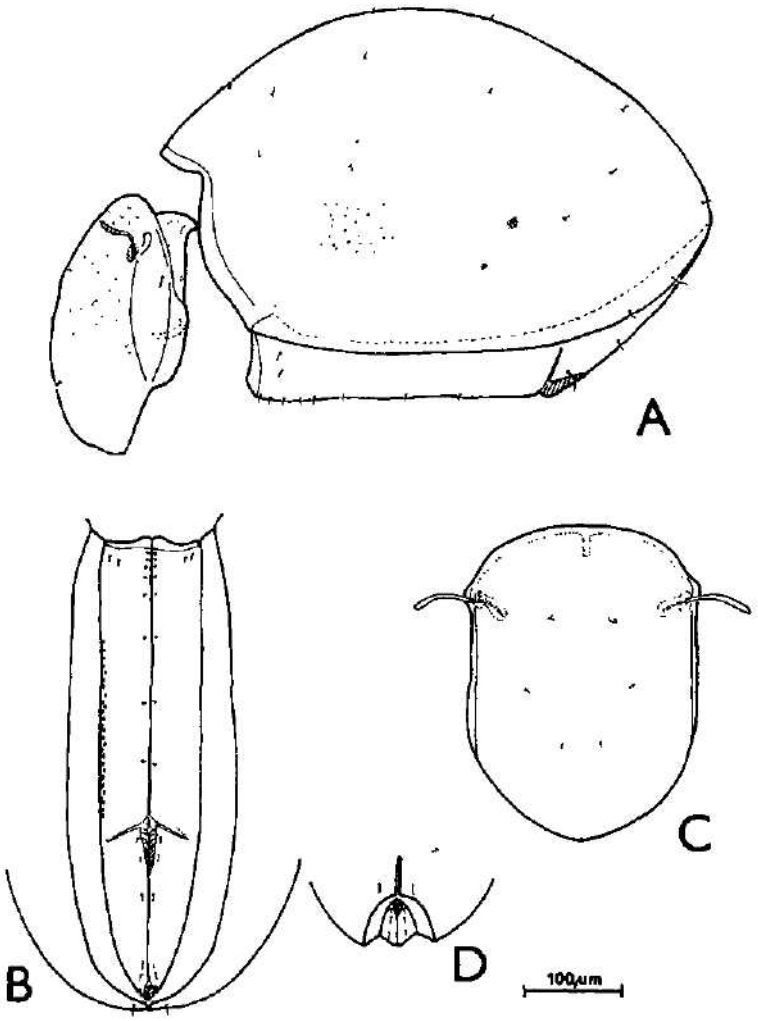


Fig. 4. *Pocsia microseta* sp.n., A - lateral view on the body without legs, B - anogenotal region, ventral view, C - aspis in dorsal view, D - posterior part of the body. Scale 100 µm.

Legs (Fig. 3A-D) all monodactylous, comparatively short with long setae especially solenidions, chaetotactic formulae I 0-2-1(2)-5(1)-12(3)-1, II 0-2-3(1)-2(1)-13(2)-1, III 1-2-2(1)-2(1)-9-1, IV 1-1-1-2(1)-8-1.

AFFINITIES: New species is very easy distinguishable from congeners by shape of sensillus, long fissura terminalis and presence of very fine, badly observable notogastral setae. Shape of the sensillus of the new species is very similar to *M. schusteri* Märkell, 1964, but new species differs in longer sharp spike on the top of the sensillus (length of the spike of new species is more than 1 half of the length of the sensillus), by long fissura terminalis (*M. schusteri* has only sinus terminalis), and *M. schusteri* has much longer all body setae.

LOCUS TYPICUS: Cuba, Moa, 20. 11. 1981, soil sample of moder bellow Pinus sp. and *Coccothrinax* sp., leg. J. Rusek.

TYPES: holotypus Ho - 20. 11. 1981, - K-283 in etanol and 16 paratypes one in slide and others in ethanol are deposited in autors collection in the Institue of Soil Biology, Czechoslovak Academy of Sciences, České Budějovice.

*Pocsia microseta* **sp.n.** (Figs. 4A-D,5A-B,6A-D)

DIAGNOSIS: one lateral carina, tridactylous legs, very short body setae, 8 pairs of genital and 2 pairs of adgenital setae, the whole body setae equal in the length.

DESCRIPTION: length of aspis 250-282 mm, breadth of aspis 245-272 mm, length of notogaster

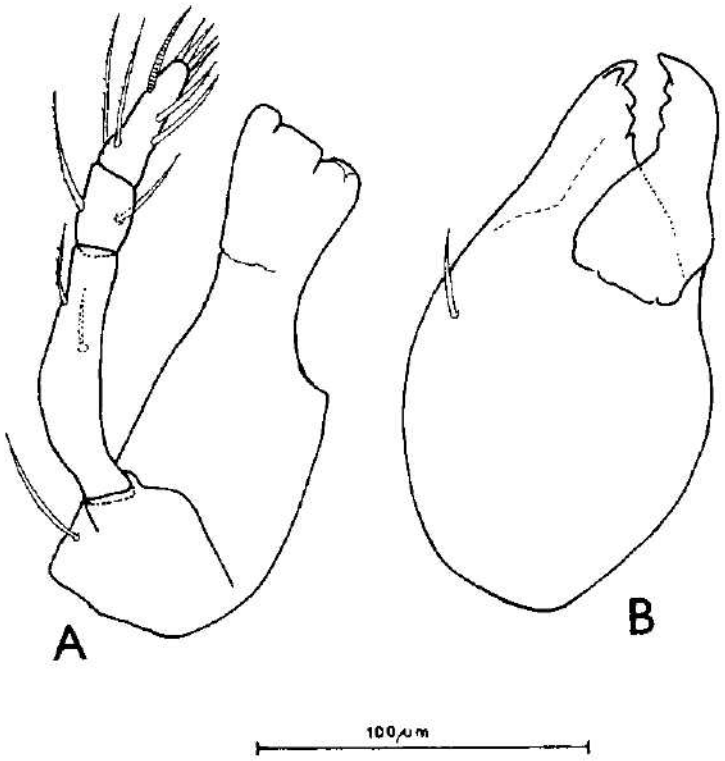


Fig. 5. *Pocsia microseta* sp.n., A - right palpus with rutelom, B - left chelicera. Scale 100 µm.

525 - 558 µm, heith of notogaster 352-385 µm, breadth of notogaster 305-323 µm. Colour ochre yellow. Cuticle fine smooth with small tenuous points.

Aspis (Fig. 4A,C) with one lateral carina on each side, anterior part of aspis without conspicuous rim, all setae on aspis fine, smooth and very short, the exobothridial setae longer than other ones on aspis, 4-5x shorter than length of sensillus. Distance between rostral setae shorter

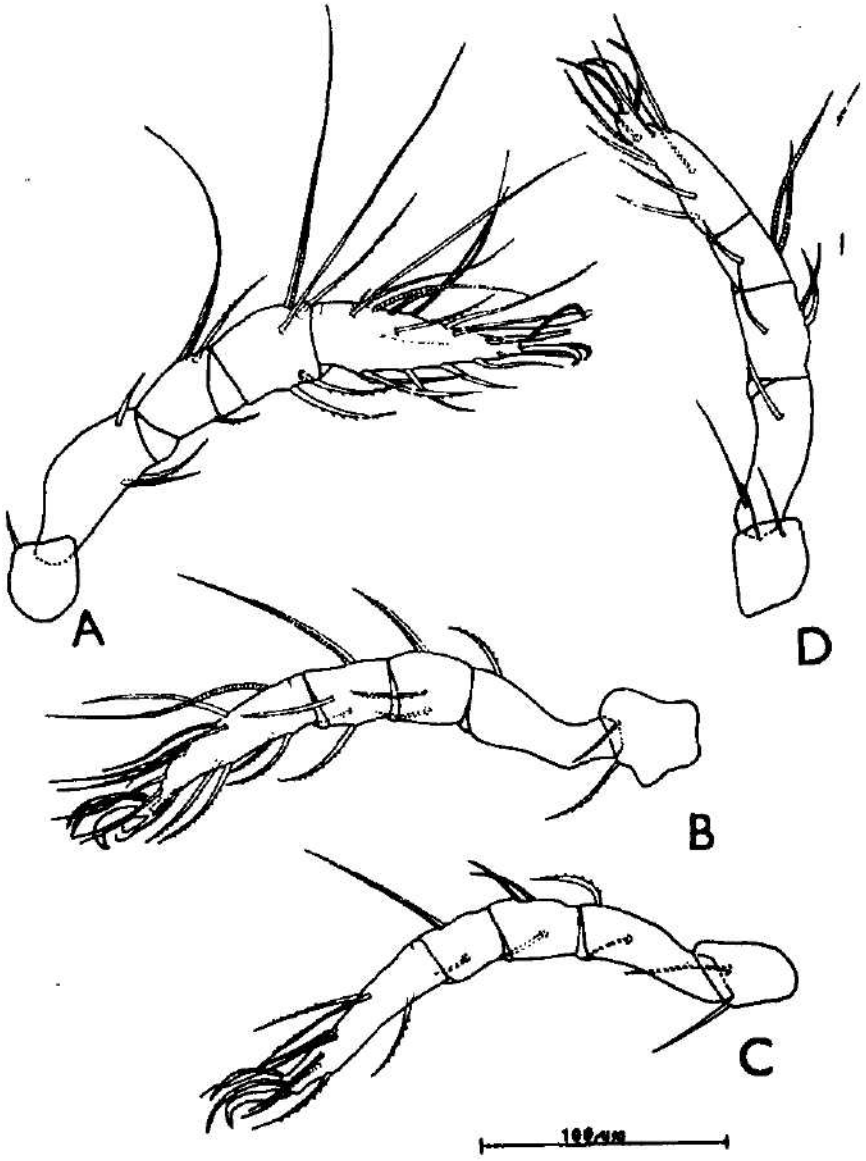


**Fig. 6.** ***Pocsia microseta*** sp.n., A - right leg I, antiaxial view, B - left leg. II antiaxial view, C - left leg III, paraxial view, D - left leg IV, paraxial view. Scale 100 µm.

than between interlamellar ones and this shorter than distance between lamellar ones. Sensillus originating in a very small bothridium, comparatively short, gradually extended and with blunt top. Little bothridial squama situated bellow bothridium.

Notogaster (Fig. 4A) oval, comparatively long, smooth, with dark collar on anterior margin of notogaster, with 14 pairs of very fine and short notogastral setae. Surface of notogaster with thin layer of cerotegument without distinct structures, ended by comparatively long fissura terminalis reaching behind the bases of the setae ps3 (Fig. 4D).

Anogenital region (Fig. 4B), genitoadgenital plates much longer than adanalanal ones, first interlocking triangle situated posteriorly, with two distinct lateral suturae, short adanal plates ended by small second interlocking triangle. All surface of this region smooth, only lateral margin of genitoadgenital plates with small spots. Genitoadgenital plates with 8 pairs of very fine, short and smooth genital setae. Setae gl-4 on anterior part of genitoadgenital plates near together than other genital ones (g 5-8). Two pairs of smooth and short adgenital setae equal in the length to genital ones. Three pairs of fine, short and smooth anal and adanal setae.

Chelicerae (Fig. 5B) large with smooth surface, without seta chb, seta cha smooth and sharped on the top. Measurements of digitus fixus 175 x 85 um, and digitus mobilis 62 x 40 µm. Digitus fixus with 5 blunt teeth and digitus mobilis with 4 ones. Trägardhs organ absent.

Palps (Fig. 5A) with three joints, comparatively slender, chaetotactic formula 2-2-8(1), originating in genae with slender rutelum with three incisions on the top.

Legs (Figs. 6A-D) comparatively long and slender, all tridactylous. Chaetotactic formulae I 1-3-4(1)-5(1)-15(3)-3, II 2-1-3(1)-4(1)-13(2)-3, III 2-2-1(2)-2(1)-8-3, IV 2-2-1(2)-1(2)-8-3.

AFFINITIES: genus *Pocsia* Mah. has been known only from Tanzania and Kenya in eastern part of Africa so far. This is first record of *Pocsia* species from Neotropical region. New species belongs evidently to the genus *Pocsia*, but has many diferences, which differs from African *Pocsia* species. We can easy distingiushed this new species from congeners by short and fine body setae, and by posterior position of the first interlocking triangle.Only P. kunsti Starý, 1988, has tridactylous legs, but this species has a long body setae and has only 5 genital setae. P. bicarinata Starý, 1991, has 8 genital setae, too, but it differs from new species in presence of two lateral carinae on the aspis and in a long body setae and monodactylous legs.

LOCUS TYPICUS: Cuba, Province Habana, Arroyo Bermejo, 16. 11. 1981, north slope, soil sample, leg. J. Rusek.

TYPES: holotypus Ho - 16. 11. 1981 - K-323, in ethanol and 4 paratypes, one on the slide and others in ethanol are deposited in author's collection in the Institute of Soil Biology, Czechoslovak Academy of Sciences, České Budějovice.

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The Check-list will be a collective work of over 30 Czech specialist and will record the knowledge of the beetle fauna of former Czechoslovakia at the end of 1992. Brief comments to the state of knowledge of particular families will be given as well as an account of the zoogeographic subdivision of the former Czechoslovakia.

The Check-list of Czechoslovak Coleoptera will be published as supplementum of Folia Heyroskyana in a separate hard-bound volume. The price could not be fixed yet, but the editor will provide all subscribers of Folia Heyrovskyana with a 50% discount.Preliminary orders should be send to the address of the Editor (see above).

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# Growth, biomass, production and survival of perch population (*Perca fluviatilis*, Percidae, Osteichthyes) in small experimental pond - Central Bohemia, Czech Republic

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**Experimental pond, *Perca fluviatilis*, Osteichthyes, abundance, growth, biomass, production, survival, Czech Republic**

**Abstract.** The growth, biomass, production and survival of an artificially stocked perch population was studied in a small experimental pond Pilský (0.33 ha) in 1981 and 1982. The total production achieved value 56.7 kg.ha-1 available production 47.6 kg.ha-1 and mean biomass 140.6 kg.ha-1 and these data are the highest out of all the data available for the perch from Czechoslovakia. The value of the annual survival S=0.700 for the whole population was calculated with maximum for the fish of the age 4-5 (S=0.906).

## INTRODUCTION

The study of the production ability of organisms is one of important problems solved in population investigations. The study of the population dynamics of the forage fish species (as e.g.perch or roach) is a one part of this research. The species play an important role in fish communities in reservoirs and in ponds as feeding competitors with other fish species.

A remarkable attention has been paid to these species from the standpoint of the research as well as their use in practice (species for consumption and sport fishery). Out of a great body of data about one of these species - Eurasian perch *(Perca fluviatilis)* are to be mentioned works of the following authors as e.g. Le Cren (1958), Ruděnko (1966, 1971), Sumari (1971), Lind et al (1974), Thorpe (1977), Nyberg (1979), Rask (1984), Rask & Arvola (1985), Craig (1987), Lappalainen et al. (1988), Mills & Hurley (1990) and others, in our country Holčík (1969, 1977) Pivnička (1979, 1982), Pivnička & Švátora (1977, 1983, 1988), Švátora & Pivnička (1981) Křížek (1987), Švátora (1989).

In the work reported here the authors observed the experimentally stocked perch population in a small pond Pilský (0.33 ha) in two seasons (1981 and 1982) and they studied the growth survival, biomass and production.

## MATERIAL AND METHODS

The experimental fish - perch (*Perca fluviatilis L.*) were stocked into the Pilský pond (0.33 ha, maximal dept 1.8 m, mean depth 0.6 m, with submerged vegetation - *Elodea canadensis* on 1/2 of its area) on Apr 10, 1981. Th pond is situated in the village Jevany near Prague (central Bohemia). In this way, we continued in an experimer started in 1978 (Pivnička & Švátora, 1983). In 1981 (Apr 10) total of 1011 specimens (age 1-7) were stocked an in 1982 (May 17) 881 specimens were caught. The perch was as the only species in the Pilský pond. The sex rati in the stocked perch population was 1:1 (fishes of age 2-7, total 776 specimens). The sex ratio was determinate

very simply because the time of stocking was before the spawn. In 1981 as well as in 1982 scales were sampled in 156 and 176 specimens respectively (samples were independently selected) and then the fishes were stocked to the pond.

In all fishes the standart length (Sl) was measured in mm, fishes were weighted with accuracy of 0.5 g. For the age determination and the back calculation of the growth the scale method was used with the correction towards the scale formation according to R. Lees method. For the back calculation of the lenghts, the 19 mm correction was adopted (Frank, 1967).

The age composition of the lenghts groups of the sample was related to the whole population (Fig. 1), the length composition of the perch population in 1981 and 1982 see Fig. 2. The data obtained were subsequently used for the calculation of the survival of the whole population stocked as well as of particular age groups.

The weight growth was evaluated with the help of the production index $P_I$ (i.e. the sum of weight increments from the 2nd to 6th age group - $P_{I(2\text{-}6)}$ (Pivnička, 1972); the total and available production (P, $P_A$) was then calculated according to Ricker (1975) and Pivnička (1972) (total production $P^t_i = \sum_{i=1}^{n} G^t_i . \bar{B}^t_i$; instantaneous coefficient of weight growth $G^t_i = \frac{\ln w^t_i - \ln w^{t-1}_i}{\Delta t}$; $w^t_i$ - weight at the time of catching, $w^{t-1}_i$ - weight at the time of anulus formation, $\Delta$ t - one year, average biomass $\bar{B}^t_i = \frac{B^t_i + B^{t-1}_i}{2}$, $B^t_i = A^t_i . w^t_i$, $A^t_i$ - number of specimens in the age group; available production $P^t_A = \sum_{i=1}^{n} A^t_i \cdot \Delta w^t_i$, $\Delta W$ - weight increment of the age group per year, $w^t_i = w^t_i - w^{t-1}_i$; weights were computed according to length - weight relationship - see Rounsefell & Everhart (1960).

## RESULTS

### Growth

In 1981 (Apr 10) 1011 fish specimens (age 1-7) were stocked.The fishes were partially taken from a preceeding experiment in this pond in 1980 (that time 192 fish of age 1-8 were stocked) and a portion came from catching in the Jevanský pond, which is situated near the experimental pond. For the age growth analyses, total of 156 specimens from 1980 were treated (Table 1) and in the 1st age group fish specimens used were born already in the Pilský pond in the season 1980/1981.

The calculated values of the production index $P_{I(2.\text{-}6)}$ = 211 g is very high, similar to values ascertained for example to reservoirs after its filling and is twice higher then our results for reservoirs from Czechoslovakia (100 g). The length - weight relationship was determined as log w = -5.558 + 3.425 log. L, r = 0.999. In the subsequent year 1982 (May 17) the fish specimens from the experimental pond were caught again and we took a revelant sample for the growth analyses (175 specimens - Table 2). Total of 881 individuals of the age 1-7 were caught (out of them 173 the 1st age group). The value of the production index of 118g is the average growth for Czechoslovak reservoirs and ponds; log w = -4.060 + 2.721 log L, r = 0.998.

The growth of perch was influenced by changes in population density in the pond (see discussion).

### Survival

In 1981-1982 the survival of the stocked perch population was followed. Out of the 1011 specimens stocked in 1981, 708 specimens were caught in 1982 (age 2 - 7). The survival of stocked fish was S = 0.700. On the basis of the age composition of samples from 1981 and 1982, after a calculation with respect to the whole population it was also possible to establish survival of individual age groups in the given period (Table 3). The highest value of survival was in age 4 - 5 (S = 0.906) with gradual decrease to the value S = 0.067 for age 6 - 7. The observation of survival of males and females separately was not followed. The high mortality of

Table 1. Length growth of the perch in Pilský pond in 1981

| age | n | $L_c$ | w | $l_1$ | $l_2$ | $l_3$ | $l_4$ | $l_5$ | $l_6$ | $l_7$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 14 | 65 | 4.6 | 65 | | | | | | |
| 2 | 33 | 100 | 20 | 62 | 100 | | | | | |
| 3 | 22 | 121 | 36 | 62 | 100 | 121 | | | | |
| 4 | 37 | 167 | 119 | 62 | 97 | 137 | 167 | | | |
| 5 | 39 | 184 | 156 | 61 | 103 | 142 | 165 | 184 | | |
| 6 | 8 | 209 | 239 | 62 | 104 | 137 | 168 | 190 | 209 | |
| 7 | 3 | 208 | 240 | 60 | 94 | 117 | 151 | 178 | 194 | 208 |
| Tot | 156 | average | | 62 | 100 | 131 | 163 | 184 | 202 | 208 |

Table 2. Length growth of the perch in the Pilský pond in 1982

| age | n | $L_c$ | w | $l_1$ | $l_2$ | $l_3$ | $l_4$ | $l_5$ | $l_6$ | $l_7$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 33 | 59 | 6.0 | 59 | | | | | | |
| 2+ | 33 | 101 | 25 | 61 | 96 | | | | | |
| 3+ | 22 | 125 | 43 | 63 | 99 | 121 | | | | |
| 4+ | 32 | 162 | 94 | 60 | 99 | 133 | 158 | | | |
| 5+ | 39 | 195 | 156 | 63 | 105 | 140 | 177 | 191 | | |
| 6+ | 15 | 193 | 147 | 62 | 103 | 137 | 161 | 180 | 191 | |
| 7+ | 1 | 220 | 194 | 62 | 95 | 127 | 151 | 181 | 203 | 218 |
| Tot | 175 | average | | 61 | 100 | 132 | 162 | 184 | 197 | 218 |

Table 3. Survival rate (S) of the stocked perch, the Pilský pond, 1981 to 1982

| age | 1 - 2 | 2 - 3 | 3 - 4 | 4 - 5 | 5 - 6 | 6 - 7 |
|---|---|---|---|---|---|---|
| S | 0.489 | 0.844 | 0.742 | 0.906 | 0.543 | 0.067 |

older age groups (6 - 7) is also in agreement with our data from the whole Jevany pond system where only minimum perches older then 8 year we founded (0.5 - 3 % from the whole sample studied - n = 2 500 fishes). The high value of the survival for age 1 - 2 (S = 0.489) can be influenced by the fact that one half of the pond was with submerged vegetation and so on the predation preasure of older perches was not so high.

Biomass and production

For the period 1981 - 1982 the following values were established - mean biomass $\bar{B}$ = 140.6 $kg.ha^{-1}$, total production P = 56.7 $kg.ha^{-1}$ and available production $P_A$ = 47.6 $kg.ha^{-1}$ , $P_a$ (for the age 4 - $\infty$) = 22.6 $kg.ha^{-1}$. These data are the first data from pond in Czechoslovakia and indicate the production possiblities of similar small ponds in Czechoslovakia.

## DISCUSSION

Our study is the first concerning about the biomass, production and survival on the perch population in a small pond in Czechoslovakia.

The calculated value of the production index $P_{I(2.-6.)}$ = 211 g is very high, similar to values ascertained for example in the Slapy reservoir after its filling - 218 g (Frank, 1960) or in the Velký Tisý pond - 204 g (Švátora, 1974; 1989). Švátora (1989) reports $P_I$ = 100 g for reservoirs and the general average value (reservoirs and ponds) - 129 g. In the case of the Pilský pond the growth was strongly affected by the abundance of the population stocked - at the time of catching in 1982 the fish population of age 2 - 7 was of 2 145 spec.ha$^{-1}$ (in 1981 the corresponding abundance was 430 spec.ha$^{-1}$ - spring 1981, before the new experiment). For a comparison it is possible to consider average values of the perch abundance from the Klíčava and Záskalská reservoirs, which achieve values of 227 spec.ha$^{-1}$ (Záskalská reservoir 1974 - 1979, range 100 - 416 spec.ha$^{-1}$), and 363 spec.ha$^{-1}$ (Klíčava reservoir 1963 - 1986, range 120 - 686 spec.ha$^{-1}$) (Švátora, 1989, Pivnička & Švátora, 1988) and corresponding values of production indices $P_I$ = 97 g (60 - 120) and 99 g (77 - 119), respectively. In these two localities, there was also negative correlation between the abundance of the population of the perch and the growth. A similar dependence was reported even more early by autors as e.g. Bagenal (1977), Thorpe (1977), LeCren (1958), Craig (1987) and others. The abundance in 1981 corresponds to values known in our country from the Klíčava reservoir (Pivnička, 1982), where, however, the perch growth was lower by one half at a similar abundance, however, in this reservoir there are also further fish species (total of 12), particularly the roach, and the total abundance of all the species of the corresponding age (2 - 8) ranges between 1 800 and 5 000 spec.ha$^{-1}$ (in average of 3 000). By increasing the abundance of the perch population in the experimental pond by the factor of 5 to a value approaching the values from the Klíčava (2 352 spec.ha$^{-1}$ stocked in 1981) the growth was reduced in the first year ($P_I$ = 118 g in 1982) to a level similar to data published from the Klíčava reservoir ($P_I$ = 97 g).

The survival is rather higher than values reported from this locality by Pivnička & Švátora (1983). These authors found that in seasons 1978/1979 and 1979/1980 survival achieved values 0.550 and 0.599 respectively (for age 2 - 8). All these values are in agreement with the older data available - for example Švátora (1989) reports S = 0.648 and S = 0.674 for the Záskalská and Klíčava reservoir, respectively, McCormack (1965) S = 0.69 for the lake Windermere, Willemsen (1977) S = 0.42 for the lake Ijssel (on the base of marking the fish). For the yellow perch (*Perca flavescens*) Smith (1977) found S = 0.77 - 0.80, with the highest survival in the age 4 - 5 years - S = 0.85 , Schneider (1972) reports S = 0.51 - 0.63 for the age 2 - ∞ and Nelson & Walburg (1977) found S = 0.46 for the whole population and 0.13 for the period between the 1st and the 2nd age group.

In the perch population in the Pilský pond the highest survival was also in the age 4 - 5 years S = 0.906 , which value is similar to data reported by Smith (1977). In the age 1 - 2 we found higher values than those typically presented in the literature - S = 0.489. For the Záskalská reservoir Švátora (1989) found S = 0.19 for the age 1 - 2. A very low survival was found in the Pilský pond between the age 6 - 7 - S = 0.067; similar low values was also found for this age (6 - 7) by Švátora (1989) in the Záskalská reservoir - S = 0.179. These data correspond with the mean age of the perch in our reservoirs and ponds where fishes older then 8 - 9 years are rare, e.g. in the Klíčava reservoir (Švátora 1974, Pivnička & Švátora, 1988) perches older then 8 year were 0.3 % only (n = 4 745 fishes).

Our data concerning the biomass and production of the perch population in the Pilský pond ($\bar{B}$ = 140.6 kg.ha$^{-1}$;total production $P_A$ = 47.6 kg.ha$^{-1}$, $P_A$ (for age 4 - ∞) = 22.6 kg.ha$^{-1}$) are very high with comparison to others from Czechoslovakia. For the Záskalská reservoir Švátora

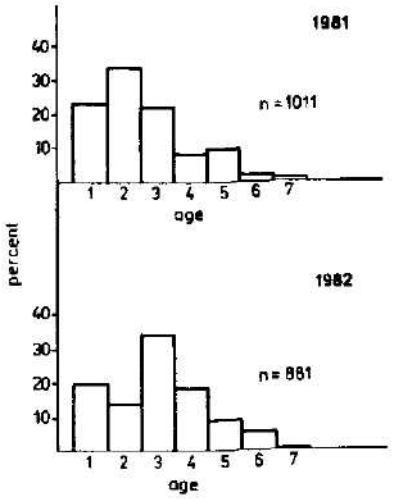


Fig. 1. Percentage age composition for the perch population in the Pilský pond in 1981 and 1982.

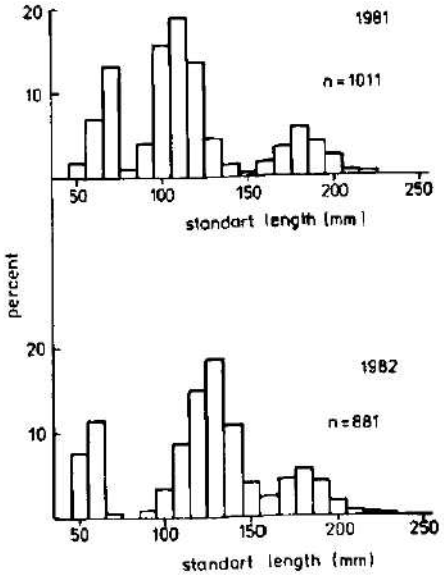


Fig. 2. Length-frequency histograms for the perch population stocked into the Pilský pond in 1981 and 1982.

(1989) reports values founded in 1977 - $\overline{B}$ = 15.9 kg.ha$^{-1}$, P = 6.2 kg.ha$^{-1}$, $P_A$ (4 - ∞) = 4.4 kg.ha$^{-1}$ and Švátora (l.c.) and Pivnička (1972) for the Klíčava reservoir (1963 - 1979) - $\overline{B}$ = 14.5 (8.1 - 20.8), P = 6.8 (4.4 - 10.5), $P_A$ = 8.5 (3.6 - 16.9), $P_A$ (4 - ∞) = 1.9 (0.4 - 5.6), however, in the reservoir, there were also further species together with the perch, which formed a prevalent part of biomass of the given reservoirs. The biomass of the perch in lakes and reservoirs may be as high as 100 kg, exceptionally higher (e.g. Kipling & LeCren (1984) report the biomass of 43 to 116 kg.ha$^{-1}$ for the Windermere lake; Persson (1986) 73 and 173 kg.ha$^{-1}$ for the lake Soderborg and the roach biomass in this lake was of 264 and 155 kg.ha$^{-1}$, respectively). The amount of the biomass depends on whether the perch is present of the given lokality only alone (so called perch lakes) or together with the further species (most typically with the roach) In the first case the biomass values mostly range between 18 and 40 kg.ha$^{-1}$, in the second case between 5 and 23 kg.ha$^{-1}$ (Ruděnko, 1966,1971; Sumari, 1971; Nyberg, 1979; Lind et al., 1974; Rask, 1984; Rask & Arvola, 1985; Lappalainen et al., 1988) except for data by Persson (1986) The production is mostly between 4 and 12 kg.ha$^{-1}$. Lind et al. (1974) found a production of 9.9 kg.ha$^{-1}$ in the lake Kiutajärvi, Nyberg (1979) 7.5 and 11.2 kg.ha$^{-1}$ in lakes Vitalampa and Botjärn and Carlander (1977) reports the production value of 21.9 kg.ha$^{-1}$ for the yellow perch (Perca flavescens). With respect to the values mentioned, our data are higher, which is however, due to the fact that the perch was the only species in the given pond.

The data about the perch biomass and production ascertained here are the highest values for our territory and they are even higher than most data from localities outside of Czechoslovakia.

## SUMMARY

The growth, biomass, production and survival of an artificially stocked population of the perch in a small pond (Pilský - 0.33 ha) were studied between 1981 and 1982. The weight growth was evaluated with the help of the production index $P_I$ and it was affected by the abundance of the fish stocked (very rapid in 1980 - 1981 - N = 430 spec.ha$^{-1}$ (spring 1981, age 2 - 7), $P_{I(2-6)}$ = 211 g; average in 1981 - 1982 - N = 2 145 spec.ha$^{-1}$ (spring 1982, age 2 - 7), $P_{I(2-6)}$ = 118 g). The value of the annual survival S = 0.700 for the whole perch population was calculated. This value ranges between values ascertained for the perch populations in our country Maximal survival values are achieved by the fish of the age 2 - 5 (from 0.742 to 0.906), and survival strongly decreases for the age 6 - 7 (0.067). The ascertained production and biomass values - total production P = 56.7 kg.ha$^{-1}$, available production $P_A$ = 46.6 kg.ha$^{-1}$, mean biomass $\overline{B}$ = 140.6 kg.ha$^{-1}$ are the highest values out of all the data available for the perch from Czechoslovakia.

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**Short note**

# Occurrence of *Aethus flavicornis* (Heteroptera: Cydnidae) in former Czechoslovakia

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**Distribution, diagnostic characters, bionomy, sand dune biotop**

**Abstract.** Psammophilous species *Aethus flavicornis* (Heteroptera: Cydnidae) was reported from several localities in Moravia and Bohemia, and from one locality in Slovakia during the 19th and 20th centuries. This species is recently known only from one locality in Bohemia.

Hoberlandt (1977), in check list of Czechoslovak Heteroptera, listed psammophilous cydnid *Aethus flavicornis* (Fabricius, 1794) from Bohemia, Moravia, and Slovakia. The same author (Hoberlandt, 1959) previously mentioned infrequent occurrence of this species on sandy localities in Czechoslovakia. *A. flavicornis* is, however, known in reality from probably only one locality in Bohemia at the present time.

*A. flavicornis* was found only near Bratislava (7868) (Sabransky, 1891) in Slovakia last century (see map in fig. 1). More localities of *A. flavicornis* existed in Moravia (Stehlík, 1983): Mutěnice (7168), Nebovidy (6865), Brno - Ostopovice (6865), Brno - Kamenný vrch (6865), Čejč (7067). All data about occurrence of *A. flavicornis* in Moravia have originated from a period before the year 1958. This species has not been again collected in Slovakia nor in Moravia during last years (Stehlík, 1983; Stehlík & Vavřínová, 1993).

*A. flavicornis* was mentioned by Duda (1885) from several localities in Bohemia: vicinity of Prague (5852,5853,5952,5953), near Rovensko (5557), Tábor (6554), Soběslav (6754), and Cheb (5940). The last records about the occurrence of *A. flavicornis* in Bohemia are from the year 1963. Štys (1963) listed *A. flavicornis* in list of Czechoslovak Pentatomoidea (locality omitted). Štys (personal communication, unpublished data) collected this species on sand dunes near Veselí nad Lužnicí (6854) (11.4.1963, Southern Bohemia) and closely Kozly (5753) near Neratovice (10.4.1963, Central Bohemia). Both localities mentioned are already several years entirely destroyed.

Hüeber (1891) briefly summarized a distribution of *A. flavicornis*. This species occurred in Central and Southern Europe; Duda's (1885) paper had been quoted as a source of information about a distribution of *A. flavicornis* in Bohemia.

A new locality, on which *A. flavicornis* occurs, has been discovered during complete investigation of sandy localities in Bohemia. *A. flavicornis* was found out in high density of specimens on a remainder of sand dune near the river Labe during last years This dune lies on the periphery of the village Tuhaň (5653) (near Neratovice, Central Bohemia). It is strongly influenced by human activities which, however, do not collide with a presence of typical psammophilous flora and fauna.

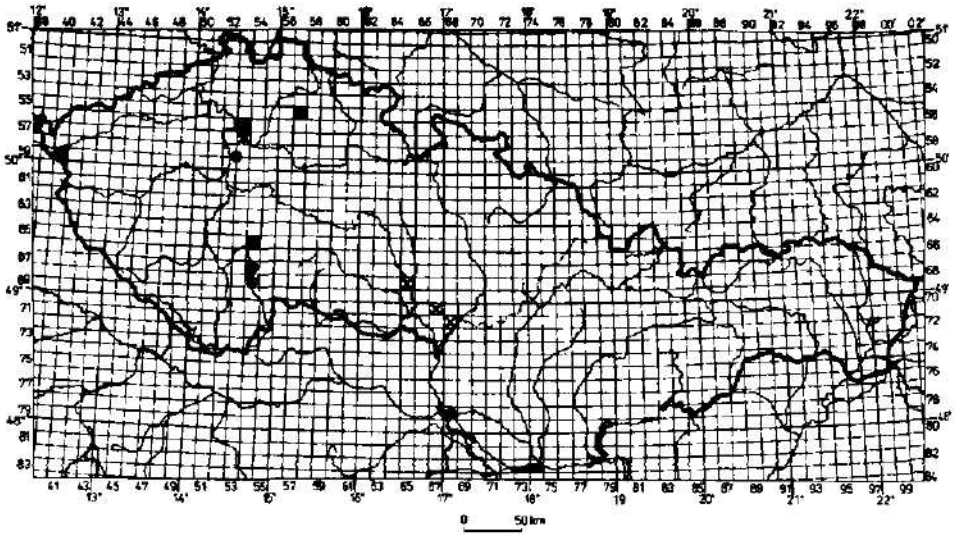
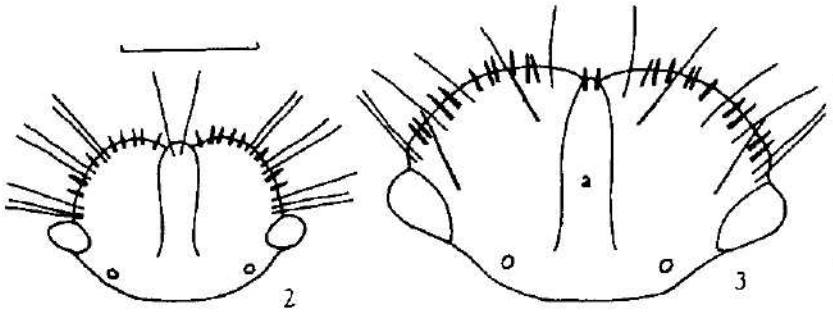


*Fig.1 - findings of Aethus flavicornis*, ● - before the year 1992, x - between the years 1920-1960, * - after the year 1960, ■ - in the present time.

*A. flavicornis* occurs either under fragments, remainders of boards, litter, etc., or more frequently under tufts of psammophilous grass *Corynephorus canescens* (L.) P. Beauv. Michalk (1938) and Eckerlein (1962) mentioned the same plant [as its junior synonym *Weingaertneria canescens* (L.)] in relation with *A. flavicornis*. The former author described a copulation of *A. flavicornis* under tufts of *Oenothera biennis L.*

Both adults and nymphs move in detritus or on sand; they immediately quickly burrow deeply to a sand after disturbance. Stehlík (1983) and Wagner (1966) provided detailed description of a way of the life of *A. flavicornis*. An occurrence of adults of *A. flavicornis* during year seasons was mentiond by several authors, e.g., Michalk (1938); and Burghardt & Rieger (1978).

*A. flavicornis* was collected several times during the year 1989 (22.3.; 1.6.; 7.9.), together with closely related species *Aethus nigritus* (Fabricius, 1794). The described locality was strongly damaged throughout activities on the periphery of the village during spring 1990. *A. flavicornis* survived probably in very low population density during the years 1990 and 1991. It has




Figs 2,3 - head, dorsal view; 1 - *Aethus flavicornis*, 2 - *Aethus nigritus*. a = anteclypeus. Scale: 0.5 mm for both figs.

appeared again in conspicuously high density in the year 1992 (15.5.; 15.8.; 12.9.); adults were collected during the whole year, nymphs in summer. *A. nigritus* has not been found at all this year.

Two very similar species - *A. flavicornis* and *A. nigritus* can be distinguished after the following characters (Hoberlandt, 1959; Wagner, 1966):

| *A. flavicornis* | *A. nigritus* |
|---|---|
| size 2.5 - 3.7 mm; | size 4.0 - 5.0 mm; |
| apex of anteclypeus with two long, fine hairs (Fig. 2); | apex of anteclypeus with two short, thick setae (Fig. 3); |
| venter of abdomen with sparse, long hairs. | venter of abdomen without long hairs. |

The small remainder of sand dune near Tuhaň is very probably the last locality with population of *A. flavicornis*. This typical psammophilous species of bug has quickly vanished in our country, just as all representatives of psammophilous entomofauna, because of drastic destruction of sandy places.

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